Appendix L

STORMWATER MANAGEMENT PLAN

PRELIMINARY MAJOR

STORM WATER MANAGEMENT PLAN

CALIFORNIA CROSSINGS

COUNTY OF SAN DIEGO, CA

JUNE 2010

Prepared For:

Otay Mesa Crossing, LLC
c/o Erwin Bucy & David Weber, Regency Centers
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And
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Prepared By:

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PDC Job No. 3315.00

Major Stormwater Management Plan
(Major SWMP)
For
California Crossings

Preparation/Revision Date: June 2010

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The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan have been prepared under the direction of the following Registered Civil Engineer and meet the requirements of Regional Water Quality Control Board Order R9-2007-0001 and subsequent amendments.

_____
Debby Reece, PE RCE 56148
Registration Expires 12/31/10

_____
Date

The Major Stormwater Management Plan (Major SWMP) must be completed in its entirety and accompany applications to the County for a permit or approval associated with certain types of development projects. To determine whether your project is required to submit a Major or Minor SWMP, please reference the County's Stormwater Intake Form for Development Projects.

Project Name:	**California Crossings**
Project Location:	Otay Mesa Road & Harvest Road
Permit Number (Land Development Projects):	P06-102, TPM21046
Work Authorization Number (**CIP only**):	
Applicant:	Otay Mesa Crossing, LLC
Applicant's Address:	Regency Centers 915 Wilshire Boulevard, Suite 2200 Los Angeles, CA 90017
Plan Prepared By (*Leave blank if same as applicant*):	Project Design Consultants
Preparer's Address:	701 B Street, Suite 800 San Diego, CA 92101
Date:	June 2010

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9926) requires all applications for a permit or approval associated with a Land Disturbance Activity to be accompanied by a Storm Water Management Plan (SWMP) (section 67.806.b). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority development project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Stages	Does the SWMP need revisions?		If YES, Provide Revision Date
	YES	NO	
Proposed Major Use Permit & Tentative Parcel Map	√		11/13/07
Proposed Major Use Permit & Tentative Parcel Map	√		3/10/08
Proposed Major Use Permit & Tentative Parcel Map	√		7/2/09
Proposed Major Use Permit & Tentative Parcel Map	√		11/5/09
Proposed Major Use Permit & Tentative Parcel Map	√		4/8/2010

Instructions for a Major SWMP can be downloaded at
http://www.sdcounty.ca.gov/dpw/watersheds/susmp/susmp.html

Completion of the following checklists and attachments will fulfill the requirements of a Major SWMP for the project listed above.

STEP 1

PRIORITY DEVELOPMENT PROJECT DETERMINATION

TABLE 1: IS THE PROJECT IN ANY OF THESE CATEGORIES?

Yes ❑	No ☒	A	Housing subdivisions of 10 or more dwelling units. Examples: single-family homes, multi-family homes, condominiums, and apartments.
Yes ☒	No ❑	B	Commercial—greater than one acre. Any development other than heavy industry or residential. Examples: hospitals; laboratories and other medical facilities; educational institutions; recreational facilities; municipal facilities; commercial nurseries; multi-apartment buildings; car wash facilities; mini-malls and other business complexes; shopping malls; hotels; office buildings; public warehouses; automotive dealerships; airfields; and other light industrial facilities.
Yes ❑	No ☒	C	Heavy industry—greater than one acre. Examples: manufacturing plants, food processing plants, metal working facilities, printing plants, and fleet storage areas (bus, truck, etc.).
Yes ❑	No ☒	D	Automotive repair shops. A facility categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539.
Yes ☒	No ❑	E	Restaurants. Any facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the land area for development is greater than 5,000 square feet. Restaurants where land development is less than 5,000 square feet shall meet all SUSMP requirements except for structural treatment BMP and numeric sizing criteria requirements and hydromodification requirements.
Yes ❑	No ☒	F	Hillside development greater than 5,000 square feet. Any development that creates 5,000 square feet of impervious surface and is located in an area with known erosive soil conditions, where the development will grade on any natural slope that is twenty-five percent or greater.
Yes ❑	No ☒	G	Environmentally Sensitive Areas (ESAs). All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.
Yes ☒	No ❑	H	Parking lots 5,000 square feet or more or with 15 or more parking spaces and potentially exposed to urban runoff.
Yes ☒	No ❑	I	Street, roads, highways, and freeways. Any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles.
Yes ❑	No ☒	J	Retail Gasoline Outlets (RGOs) that are: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.

To use the table, review each definition A through K. If any of the definitions match, the project is a Priority Development Project. Note some thresholds are defined by square footage of impervious area created; others by the total area of the development. Please see special requirements for previously developed sites and project exemptions on page 6 of the County SUSMP.

STEP 2

PROJECT STORMWATER QUALITY DETERMINATION

Total Project Site Area ___29.6 acres (Acres or ft^2)

Estimated amount of disturbed acreage: __29.6 acres__ (Acres or ft^2)
(If >1 acre, you must also provide a WDID number from the SWRCB) WDID: _(during final engineering)_____

Complete A through C and the calculations below to determine the amount of impervious surface on your project before and after construction.

A. Total size of project site: __29.6 acres_____ (Acres or ft^2)

B. Total impervious area (including roof tops) before construction __0 +/-__ (Acres or ft^2)

C. Total impervious area (including roof tops) after construction __25.2 acres ___(Acres or ft^2)

Calculate percent impervious before construction: B/A = ___0 +/-____%
Calculate percent impervious after construction: C/A = ___85 +/-____%

Please provide detailed descriptions regarding the following questions:

TABLE 2: PROJECT SPECIFIC STORMWATER ANALYSIS

1.	Please provide a brief description of the project.
The project consists of constructing a 355,918 ft^2 regional retail commercial center with associated surface parking, utilities, landscaping, and hardscape. The retail space will include a Target, three major commercial buildings, one sub-major commercial structure, three buildings of shops, and two pads. The Target and the three major structures will each have their own loading area.	
2.	Describe the current and proposed zoning and land use designation.
Existing zoning: S88 Commercial Center Overlay (East Otay Mesa Specific Plan) Proposed use: retail / commercial	
3.	Describe the pre-project and post-project topography of the project. (Show on Plan)
Under existing conditions, the project area currently consists of flat terrain sloping in the south westerly direction, with natural ground cover. Some offsite area along the North and East sides of the project contribute runon to the site, particularly because the current condition of Harvest Road is not improved and therefore does not function as a drainage divide. Drainage along the west side of the project is collected in a concrete ditch and directed to the south. A precast double 6'x2' (1.8x0.6m) RCB recently built per the Caltrans plans collects the runoff in the southwest corner of the site and conveys it to the south underneath Otay Mesa Road. A very small portion of the northwest corner of the site drains to the north in the ditch built per the Caltrans plans. The precast double RCB discharges to unnamed intermittent streams in the area, which empties into the Tijuana River. Under proposed conditions, the project grading will be designed to drain to the southwest corner of the site to match existing conditions. The site will provide onsite detention to ensure that runoff resulting from the developed condition is equal to or less than the runoff from the existing condition in order to discharge into the existing double 6'x2' (1.8x0.6m) RCB. In the proposed condition, the offsite runoff east of Harvest Road will be collected by a storm drain extension in Otay Mesa Road so that the offsite water will still drain to the existing culvert.	
4.	Describe the soil classification, permeability, erodibility, and depth to groundwater for LID and Treatment BMP consideration. (Show on Plan) If infiltration BMPs are proposed, a Geotechnical Engineer must certify infiltration BMPs in Attachment E.
The soil in the area is well-drained Diablo and Salinas Clay. The permeability varies from 0.06 in/hr to 0.57 in/hr. The water table is more than 80 inches deep. Bioretention areas are not considered infiltration BMPs, however, a geotechnical engineer will be consulted during final design of the proposed BMPs.	
5.	Describe if contaminated or hazardous soils are within the project area. (Show on Plan)
Krazan & Associates, Inc. prepared a *Phase I Environmental Site Assessment* for the	

Approximately 153-Acre Vacant Parcel of Land NWC of Otay Mesa and Harvest Roads, of which this project is a part. With regard to the project area, "Krazan recommends conducting a LSA [Limited Soil Assessment] to identify environmentally-persistent pesticides and herbicides which may have been used in past on-site agricultural operations." A summary of the report findings has been included in Attachment E.	
6.	Describe the existing site drainage and natural hydrologic features. (Show on Plan).
See response to #3 above.	
7.	Describe site features and conditions that constrain, or provide opportunities for stormwater control, such as LID features.
Soils onsite are within Hydrologic Soil Type D, therefore the infiltration rate into native soils is one constraint for implementing infiltration BMPs.	
8.	Is this project within the environmentally sensitive areas as defined on the maps in Appendix A of the *County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects?*
Yes	☒ No
9.	Is this an emergency project?
Yes	☒ No

CHANNELS & DRAINAGES

Complete the following checklist to determine if the project includes work in channels.

TABLE 3: PROJECT SPECIFIC STORMWATER ANALYSIS

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project include work in channels?		X		If YES go to 2 If NO go to 13.
2.	Will the project increase velocity or volume of downstream flow?				If YES go to 6.
3.	Will the project discharge to unlined channels?				If YES go to. 6.
4.	Will the project increase potential sediment load of downstream flow?				If YES go to 6.
5.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect downstream channel stability?				If YES go to 8.
6.	Review channel lining materials and design for stream bank erosion.				Continue to 7.
7.	Consider channel erosion control measures within the project limits as well as				Continue to 8.

No.	CRITERIA	YES	NO	N/A	COMMENTS
	downstream. Consider scour velocity.				
8.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 9.
9.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.				Continue to 10.
10.	Include, if appropriate, detention facilities to reduce peak discharges.				Continue to 11.
11.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.				Continue to 12.
12.	Provide other design principles that are comparable and equally effective.				Continue to 13.
13.	End	X			

TEMPORARY CONSTRUCTION BMPS

Please check the construction BMPs that may be implemented during construction of the project. The applicant will be responsible for the placement and maintenance of the BMPs incorporated into the final project design.

- ☒ Silt Fence
- ☒ Fiber Rolls
- ☒ Street Sweeping and Vacuuming
- ☒ Storm Drain Inlet Protection
- ☒ Stockpile Management
- ☒ Solid Waste Management
- ☒ Stabilized Construction Entrance/Exit
- ☐ Dewatering Operations
- ☒ Vehicle and Equipment Maintenance
- ☒ Desilting Basin
- ☒ Gravel Bag Berm
- ☒ Sandbag Barrier
- ☒ Material Delivery and Storage
- ☒ Spill Prevention and Control
- ☒ Concrete Waste Management
- ☒ Water Conservation Practices
- ☒ Paving and Grinding Operations

☒ Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval.

EXCEPTIONAL THREAT TO WATER QUALITY DETERMINATION

Complete the checklist below to determine if a proposed project will pose an "exceptional threat to water quality," and therefore require Advanced Treatment Best Management Practices during the construction phase.

TABLE 4: EXCEPTIONAL THREAT TO WATER QUALITY DETERMINATION

No.	CRITERIA	YES	NO	INFORMATION
1.	Is all or part of the proposed project site within 200 feet of waters named on the Clean Water Act (CWA) Section 303(d) list of Water Quality Limited Segments as impaired for sedimentation and/or turbidity? Current 303d list may be obtained from the following site: http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/approved/r9_06_303d_reqtmdls.pdf		X	If YES, continue to 2. If NO, go to 5.
2.	Will the project disturb more than 5 acres, including all phases of the development?			If YES, continue to 3. If NO, go to 5.
3.	Will the project disturb slopes that are steeper than 4:1 (horizontal: vertical) with at least 10 feet of relief, and that drain toward the 303(d) listed receiving water for sedimentation and/or turbidity?			If YES, continue to 4. If NO, go to 5.
4.	Will the project disturb soils with a predominance of USDA-NRCS Erosion factors k_f greater than or equal to 0.4?			If YES, continue to 6. If NO, go to 5.
5.	Project is not required to use Advanced Treatment BMPs.	X		Document for Project Files by referencing this checklist.
6.	Project poses an "exceptional threat to water quality" and is required to use Advanced Treatment BMPs.			Advanced Treatment BMPs must be consistent with WPO section 67.811(b)(20)(D) performance criteria

Exemption potentially available for projects that require advanced treatment: Project proponent may perform a Revised Universal Soil Loss Equation, Version 2 (RUSLE 2), Modified Universal Soil Loss Equation (MUSLE), or similar analysis that shows to the County official's satisfaction that advanced treatment is not required

STEP 3

HYDROMODIFICATION DETERMINATION

The following questions provide a guide to collecting information relevant to hydromodification management issues.

TABLE 5: HYDROMODIFICATION DETERMINATION

	QUESTIONS	YES	NO	Information
1.	Will the proposed project disturb 50 or more acres of land? (Including all phases of development)		X	If YES, continue to 2. If NO, go to 6.
2.	Would the project site discharge directly into channels that are concrete-lined or significantly hardened such as with rip-rap, sackcrete, etc, downstream to their outfall into bays or the ocean?			If NO, continue to 3. If YES, go to 6.
3.	Would the project site discharge directly into underground storm drains discharging directly to bays or the ocean?			If NO, continue to 4. If YES, go to 6.
4.	Would the project site discharge directly to a channel (lined or un-lined) and the combined impervious surfaces downstream from the project site to discharge at the ocean or bay are 70% or greater?			If NO, continue to 5. If YES, go to 6.
5.	Project is required to manage hydromodification impacts.			Hydromodification Management Required as described in Section 67.812 b(4) of the WPO.
6.	Project is not required to manage hydromodification impacts.	X		Hydromodification Exempt. Keep on file.

An exemption is potentially available for projects that are required (No. 5. in Table 5 above) to manage hydromodification impacts: The project proponent may conduct an independent geomorphic study to determine the project's full hydromodification impact. The study must incorporate sediment transport modeling across the range of geomorphically-significant flows and demonstrate to the County's satisfaction that the project flows and sediment reductions will not detrimentally affect the receiving water to qualify for the exemption.

STEP 4

POLLUTANTS OF CONCERN DETERMINATION

WATERSHED

Please check the watershed(s) for the project.

☐ San Juan 901	☐ Santa Margarita 902	☐ San Luis Rey 903	☐ Carlsbad 904
☐ San Dieguito 905	☐ Penasquitos 906	☐ San Diego 907	☐ Sweetwater 909
☐ Otay 910	☒ Tijuana 911	☐ Whitewater 719	☐ Clark 720
☐ West Salton 721	☐ Anza Borrego 722	☐ Imperial 723	

http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

HYDROLOGIC SUB-AREA NAME AND NUMBER(S)

Number	Name
911.12	Water Tanks Hydrologic Sub-area

http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

SURFACE WATERS that each project discharge point proposes to discharge to. List the impairments identified in Table 7.

SURFACE WATERS (river, creek, stream, etc.)	Hydrologic Unit Basin Number	Impairment(s) listed [303(d) listed waters or waters with established TMDLs]	Distance to Project
Unnamed Intermittent Streams	911.12	Downstream 303(d) (2006) impaired water body = Tijuana River. The Tijuana River is listed for eutrophic conditions, indicator bacteria, low dissolved oxygen, pesticides, solids, synthetic organics, trace elements, and trash.	Approximately 6.25 miles southwest by way of unnamed intermittent streams in the area.

http://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/303dlists2006/epa/r9_06_303d_reqtmdls.pdf

GROUND WATERS

Ground Waters	Hydrologic Unit Basin Number	MUN	AGR	IND	PROC	GWR	FRESH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Water Tanks HSA	911.12	○	○	○												

http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

+ Excepted from Municipal ● Existing Beneficial Use ○ Potential Beneficial Use

PROJECT ANTICIPATED AND POTENTIAL POLLUTANTS

Using Table 6, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

TABLE 6: ANTICIPATED AND POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE

	General Pollutant Categories								
PDP Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development 1 acre or greater	**P(1)**	**P(1)**		**P(2)**	**X**	**P(5)**	**X**	**P(3)**	**P(5)**
Heavy industry /industrial development	X		X	X	X	X	X		
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					**X**	**X**	**X**	**X**	
Hillside Development >5,000 ft^2	X	X			X	X	X		X
Parking Lots	**P(1)**	**P(1)**	**X**		**X**	**P(1)**	**X**		**P(1)**
Retail Gasoline Outlets			X	X	X	X	X		
Streets, Highways & Freeways	**X**	**P(1)**	**X**	**X(4)**	**X**	**P(5)**	**X**		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

PROJECT POLLUTANTS OF CONCERN SUMMARY TABLE

Please summarize the identified project pollutant of concern by checking the appropriate boxes in the table below and list any surface water impairments identified. Pollutants anticipated to be generated by the project, which are also causing impairment of receiving waters, shall be considered the primary pollutants of concern. For projects where no primary pollutants of concern exist, those pollutants identified as anticipated shall be considered secondary pollutants of concern.

TABLE 7: PROJECT POLLUTANTS OF CONCERN

Pollutant Category	Anticipated (X)	Potential (P)	Surface Water Impairments
Sediments	X	P	
Nutrients		P	Tijuana River is listed for eutrophic conditions and low dissolved oxygen.
Heavy Metals	X		
Organic Compounds	X	P	Tijuana River is listed for synthetic organics and low dissolved oxygen.
Trash & Debris	X		Tijuana River is listed for trash and low dissolved oxygen.
Oxygen Demanding Substances	X	P	Tijuana River is listed for eutrophic conditions and low dissolved oxygen.
Oil & Grease	X		
Bacteria & Viruses	X	P	Tijuana River is listed for indicator bacteria
Pesticides		P	Tijuana River is listed for synthetic organics and pesticides.

STEP 5

LID AND SITE DESIGN STRATEGIES

Each numbered item below is a Low Impact Development (LID) requirement of the WPO. Please check the box(s) under each number that best describes the LID BMP(s) and Site Design Strategies selected for this project.

TABLE 8: LID AND SITE DESIGN

1. Conserve natural Areas, Soils, and Vegetation
☐ Preserve well draining soils (Type A or B)
☐ Preserve Significant Trees
☐ Preserve critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions
☒ Not feasible. Description: **No type A or B soils onsite, no significant trees onsite**
2. Minimize Disturbance to Natural Drainages
☐ Set-back development envelope from drainages
☐ Restrict heavy construction equipment access to planned green/open space areas
☒ Not feasible. Description: **The site discharges to an existing concrete conveyance.**
3. Minimize and Disconnect Impervious Surfaces (see 5)
☐ Clustered Lot Design
☒ Items checked in 5
☐ Other. Description:
4. Minimize Soil Compaction
☐ Restrict heavy construction equipment access to planned green/open space areas
☒ Re-till soils compacted by construction vehicles/equipment
☒ Collect & re-use upper soil layers of development site containing organic Materials
☐ Other. Description:
5. Drain Runoff from Impervious Surfaces to Pervious Areas
LID Street & Road Design
☐ Curb-cuts to landscaping
☐ Rural Swales
☐ Concave Median
☐ Cul-de-sac Landscaping Design
☐ Other. Description:
LID Parking Lot Design
☐ Permeable Pavements
☒ Curb-cuts to landscaping

☐ Other. Description:
LID Driveway, Sidewalk, Bike-path Design
☐ Permeable Pavements
☒ Pitch pavements toward landscaping
☐ Other. Description:
LID Building Design
☐ Cisterns & Rain Barrels
☒ Downspout to swale
☐ Vegetated Roofs
☐ Other. Description:
LID Landscaping Design
☒ Soil Amendments
☒ Reuse of Native Soils
☒ Smart Irrigation Systems
☐ Street Trees
☐ Other. Description:
6. Minimize erosion from slopes
☐ Disturb existing slopes only when necessary
☒ Minimize cut and fill areas to reduce slope lengths
☒ Incorporate retaining walls to reduce steepness of slopes or to shorten slopes
☐ Provide benches or terraces on high cut and fill slopes to reduce concentration of flows
☐ Rounding and shaping slopes to reduce concentrated flow
☐ Collect concentrated flows in stabilized drains and channels
☐ Other. Description:

STEP 6

SOURCE CONTROL

Please complete the checklist on the following pages to determine Source Control BMPs. Below is instruction on how to use the checklist. (Also see instructions on page 40 of the *SUSMP)*

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.

2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your Source Control Exhibit in Attachment B.

3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in a table in your Project-Specific SUSMP.

Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternatives.

Source control BMPs will consist of measures to prevent storm water from contacting pollutants. This program will include an educational component directed at each business and their employees. Educational material developed by the County for Project Clean Water. These will include the following, which can be found in Attachment B:

- Develop a Stormwater Pollution Prevention Plan
- Train Employees
- Clean Floor Mats
- Clean Sewer Lines
- Clean Up Regularly Using Dry Methods
- Conduct Activity in Designated Areas
- Conduct Activity on Pervious Areas
- Contain and Clean up Spills
- Proper Materials Storage
- Proper Disposal of Household Hazardous Waste
- Properly Collect and Dispose of Wash Water
- Properly Handle Solid Waste

- Properly Store and Contain Oil and Grease
- Properly Dispose of Oil and Grease
- Protect Storm Drain Inlets
- Label Storm Drain Inlets
- Irrigation Controllers
- Irrigation System Maintenance
- Landscaping Erosion Prevention
- Plant Selection
- Properly Store, Use, and Dispose of Fertilizer
- Properly Store, Use, and Dispose of Pesticides
- Using Non-Toxic Products
- Weed Control
- Street and Parking Lot Sweeping
- SD-10 Site Design & Landscape Planning
- SD-11 Roof Runoff Controls
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage
- SD-31 Maintenance Bays & Docks
- SD-32 Trash Storage Areas
- SC-41 Building & Grounds Maintenance
- SC-34 Waste Handling & Disposal
- SC-30 Outdoor Loading/Unloading

The need for pesticide use will be reduced to the maximum extent practicable by including pest-resistant or well-adapted native plant varieties, groundskeepers will be educated on how to control pests using non-toxic methods, and only professional pest controllers will be used for the application of pesticides.

The catch basin within the Target loading/unloading dock will be equipped with shut-off valve and containment area (in the event of a spill) as well as a catch basin inlet insert to treat storm water.

Equipment and mats will be cleaned within the buildings or in areas that discharge to bio-swales. All mop water will be disposed of to the sanitary sewer system.

Perimeter bio-swales with curb breaks will allow runoff from ~44% of the site to enter and be treated prior to entering the storm drain system. Regular sweeping and vacuuming of the parking area and surrounding hardscape will reduce the amount of pollutants entering the storm drains and receiving waters.

A direct connection from the loading dock to the storm drain system will not be provided to be consistent with Source Control Guidelines for Loading Docks (item M per the table below.) Rather, treatment BMPs will be put in place such that there is an indirect connection to the public storm drain system instead of a direct connection.

Use the format in Table 9 below to summarize the project Source Control BMPs. Incorporate all identified Source Control BMPs in your Source Control Exhibit in Attachment B.

TABLE 9: PROJECT SOURCE CONTROL BMPS

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*
A, B, D1, D2, F, G, M, N, O, P	See table below.	See table below.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
☒ A. **On-site storm drain inlets**	☒ **Locations of inlets.**	☒ **Mark all inlets with the words "No Dumping! Flows to Bay" or similar.**	☒ **Maintain and periodically repaint or replace inlet markings.** ☒ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ☒ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
☒ B. **Interior floor drains and elevator shaft sump pumps**		☒ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	☒ **Inspect and maintain drains to prevent blockages and overflow.**
☐ C. **Interior parking garages**		☐ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
☒ D1. **Need for future indoor & structural pest control**		☒ **Note building design features that discourage entry of pests.**	☒ **Provide Integrated Pest Management information to owners, lessees, and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
☒ D2. **Landscape/ Outdoor Pesticide Use** **Note: Should be consistent with project landscape plan (if applicable).**	❑ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ❑ **Show self-retaining landscape areas, if any.** ☒ **Show stormwater treatment facilities.**	**State that final landscape plans will accomplish all of the following:** ❑ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☒ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ☒ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ☒ **Consider using pest-resistant plants, especially adjacent to hardscape.** ☒ **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☒ **Maintain landscaping using minimum or no pesticides.** ☒ **See applicable operational BMPs in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.**	❑ **If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in Fact Sheet SC-72, "Fountain and Pool Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
☒ F. **Food service**	☒ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ☒ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	☒ **Describe the location and features of the designated cleaning area.** ☒ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
☒ G. **Refuse areas**	☒ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ☒ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ☒ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	☒ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ☒ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	☒ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on Source Control Exhibit, Attachment B	3 Permanent Controls—List in SUSMP Table and Narrative	4 Operational BMPs—Include in SUSMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	❑ **Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of local Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle /equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** ❑ **Car dealerships and similar may rinse cars with water only.** ❑ **See Fact Sheet SC-21, "Vehicle and Equipment Cleaning," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the SUSMP report, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.**

❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[1] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Business Guide Sheet, "Automotive Service—Service Stations" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[1] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

☒ M. **Loading Docks**	☒ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas should be drained to the sanitary sewer where feasible. Direct connections to storm drains from depressed loading docks are prohibited.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		☒ **Move loaded and unloaded items indoors as soon as possible.** ☒ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
☒ N. **Fire Sprinkler Test Water**		☒ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	☒ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

O. **Miscellaneous Drain or Wash Water** ☒ **Boiler drain lines** ☒ **Condensate drain lines** ☒ **Rooftop equipment** ❑ **Drainage sumps** ☒ **Roofing, gutters, and trim.**		☒ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ☒ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ☒ **Rooftop mounted equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ☒ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.**	
☒ P. **Plazas, sidewalks, and parking lots.**			☒ **Plazas, sidewalks, and parking lots shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Washwater containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.**

STEP 7

LID AND TREATMENT CONTROL SELECTION

A treatment control BMP and/or LID facility must be selected to treat the project pollutants of concern identified in Table 7 "Project Pollutants of Concern". A treatment control facility with a high or medium pollutant removal efficiency for the project's most significant pollutant of concern shall be selected. It is recommended to use the design procedure in Chapter 4 of the SUSMP to meet NPDES permit LID requirements, treatment requirements, and flow control requirements. If your project does not utilize this approach, the project will need to demonstrate compliance with LID, treatment and flow control requirements. Review Chapter 2 "Selection of Stormwater Treatment Facilities" in the SUSMP to assist in determining the appropriate treatment facility for your project.

Will this project be utilizing the unified LID design procedure as described in Chapter 4 of the Local SUSMP? *(If yes, please document in Attachment D following the steps in Chapter 4 of the County SUSMP)*	
☒ Yes	No
If this project is not utilizing the unified LID design procedure, please describe how the alternative treatment facilities will comply with applicable LID criteria, stormwater treatment criteria, and hydromodification management criteria.	

- Indicate the project pollutants of concern (POCs) from Table 7 in Column 2 below.

TABLE 10: GROUPING OF POTENTIAL POLLUTANTS of Concern (POCs) by fate during stormwater treatment

Pollutant	Check Project Specific POCs	Coarse Sediment and Trash	Pollutants that tend to associate with fine particles during treatment	Pollutants that tend to be dissolved following treatment
Sediment	Secondary	X	X	
Nutrients	Primary		X	X
Heavy Metals	Secondary		X	
Organic Compounds	Primary		X	
Trash & Debris	Primary	X		
Oxygen Demanding	Primary		X	
Bacteria	Primary		X	
Oil & Grease	Secondary		X	
Pesticides	Primary		X	

- Indicate the treatment facility(s) chosen for this project in the following table.

TABLE 11: GROUPS OF POLLUTANTS and relative effectiveness of treatment facilities

Pollutants of Concern	**Bioretention Facilities (LID)**	Settling Basins (Dry Ponds)	Wet Ponds and Constructed Wetlands	Infiltration Facilities or Practices (LID)	**Media Filters**	Higher-rate biofilters*	Higher-rate media filters*	**Trash Racks & Hydro-dynamic Devices**	Vegetated Swales
Coarse Sediment and Trash	**High**	High	High	High	**High**	High	High	**High**	High
Pollutants that tend to associate with fine particles during treatment	**High**	High	High	High	**High**	Medium	Medium	**Low**	Medium
Pollutants that tend to be dissolved following treatment	**Medium**	Low	Medium	High	**Low**	Low	Low	**Low**	Low

- Please check the box(s) that best describes the Treatment BMP(s) and/or LID BMP selected for this project.

TABLE 12: PROJECT LID AND TC-BMPS

Bioretention Facilites (LID)
☒ Bioretention area/Swale
☐ Flow-through Planter
☐ Cistern with Bioretention Facility
Settling Basins (Dry Ponds)
☐ Extended/dry detention basin with grass/vegetated lining
☐ Extended/dry detention basin with impervious lining
Infiltration Facilities or Practices (LID)
☐ Infiltration basin
☐ Dry well
☐ Infiltration trench
Wet Ponds and Constructed Wetlands
☐ Wet pond/basin (permanent pool)
☐ Constructed wetland
Vegetated Swales (LID[1])
☐ Vegetated Swale

Media Filters
☐ Austin Sand Filter
☐ Delaware Sand Filter
☐ Multi-Chambered Treatment Train (MCTT)
☒ Curb or grate inlet filter (ClearWater or similar)
Higher-rate Biofilters
☐ Tree-pit-style unit
☐ Other_____
Higher-rate Media Filters
☐ Vault-based filtration unit with replaceable cartridges
☐ Other_____
Hydrodynamic Separator Systems
☐ Swirl Concentrator
☒ Baffle Separator (potential use)
Trash Racks
☐ Catch Basin Insert
☐ Catch Basin Insert w/ Hydrocarbon boom
☐ Other_____
Self-Treating or Self-Retaining Areas (LID)
☐ Pervious Pavements
☐ Vegetated Roofs
☐ Other_____

(1) Must be designed per SUSMP "Vegetated Swales" design criteria for LID credit (p. 65).

For design guidelines and calculations refer to Chapter 4 "Low Impact Development Design Guide" in the SUSMP. Please show all calculations and design sheets for all treatment facilities proposed in Attachment D.

- Create a Construction Plan SWMP Checklist for your project.

Instructions on how to fill out table

1. Number and list each measure or BMP you have specified in your SWMP in Columns 1 and Maintenance Category in Column 3 of the table. Leave Column 2 blank.

2. When you submit construction plans, duplicate the table (by photocopy or electronically). Now fill in Column 2, identifying the plan sheets where the BMPs are shown. List all plan sheets on which the BMP appears. This table must be shown on the front sheet of the grading and improvement plans.

Stormwater Treatment Control and LID BMP's			
Description / Type	Sheet	Maintenance Category	Revisions
Bioretention area/Swale	TBD	Second	
Baffle Separator	TBD	Second	
Curb or grate inlet filter (ClearWater or similar)	TBD	Second for onsite BMPs, Third for Harvest Road BMPs	

* BMP's approved as part of Stormwater Management Plan (SWMP) dated xx/xx/xx on file with DPW. Any changes to the above BMP's will require SWMP revision and Plan Change approvals.

- Please describe why the chosen treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a feasibility analysis that demonstrates utilization of a treatment facility with a high or medium removal efficiency ranking is infeasible.

Bioretention areas/swales have been selected as a primary treatment control BMP. Swales are natural BMP systems that can add to the value of the site. Studies have shown the effectiveness and efficiency of natural systems or "low-impact development" (LID) over "high-tech" systems.

Based on the site design and grading plans, not all of the runoff from the parking areas can be directed into Bioretention areas/swales. Some of the inlets will be equipped with filter inserts (Clearwater or similar) for treatment prior to entering the underground detention basin. If only some of the inlets are equipped with inserts, runoff entering the remaining inlets from the surface parking areas will be treated by a baffle separator prior to entering underground detention. In addition, the docking bay catch basins will be equipped with inlet inserts as well as shut off valves and containment areas. Target pollutants from the parking areas will consist of heavy metals, trash & debris, and oil & grease.

A Treatment BMP must address runoff from developed areas. Please provide the post-construction water quality treatment volume or flow values for the selected project Treatment BMP(s). Guidelines for design calculations are located in Chapter 4 of the County SUSMP. Label outfalls on the BMP map. The Water Quality peak rate of discharge flow (Q_{WQ}) and the Water Quality storage volume (V_{WQ}) is dependent on the type of treatment BMP selected for the project.

Outfall	**Tributary Area (acres)**	**Q_{WQ} (cfs)**	**V_{WQ} (ft^3)**
Bioretention Area 1A	2.82	0.56	
Bioretention Area 1B	2.1	0.42	
Bioretention Area 2	1.42	0.28	
Bioretention Area 3	2.88	0.58	
Bioretention Area 4	0.37	0.07	
Bioretention Area 5	1.37	0.27	
Bioretention Area 6	2.09	0.42	
All Clearwater inserts	(Max 2.4 acres to one insert)	(Max capacity = 0.46 cfs)	
Baffle Separator	11.51	2.3	

STEP 8

OPERATION AND MAINTENANCE

- Please check the box that best describes the maintenance mechanism(s) for this project.

TABLE 13: PROJECT BMP CATEGORY

CATEGORY	SELECTED		BMP Description
	YES	NO	
First			
Second[1]	**X (onsite BMPs)**		
Third[2]	**X (Harvest Road BMPs)**		
Fourth			

Note:

1. A recorded maintenance agreement will be required.
2. Project will be required to establish or be included in a Stormwater Maintenance Assessment District for the long-term maintenance of treatment BMPs.

- Please list all individual LID and Treatment Control BMPs (TC-BMPs) incorporated into project. Please ensure the "BMP Identifier" is consistent with the legend in Attachment C "LID and/or TC-BMP Exhibit". Please attach the record plan sheets upon completion of project and amend the Major SWMP where appropriate. For each type of LID or TC-BMP provide an inspection sheet in Attachment F "Maintenance Plan".

TABLE 14: PROJECT SPECIFIC LID AND TC-BMPS

BMP Identifier*	LID or TC-BMP Type	BMP Pollutant of Concern Efficiency (H,M,L) – Table 11	Final Construction Date *(to be completed by County inspector)*	Final Construction Inspector Name *(to be completed by County inspector)*
Bioretention Area 1A	Bioretention Area	H, H, M		
Bioretention Area 1B	Bioretention Area	H, H, M		
Bioretention Area 2	Bioretention Area	H, H, M		
Bioretention Area 3	Bioretention Area	H, H, M		

Bioretention Area 4	Bioretention Area	H, H, M		
Bioretention Area 5	Bioretention Area	H, H, M		
Bioretention Area 6	Bioretention Area	H, H, M		
All Clearwater inserts	Media filtration	H, H, L		
Baffle Separator	Trash racks & hydrodynamic devices	H, L, L		

* For location of BMP's, see approved Record Plan dated _XX/XX/XX_, plan (TYPE) sheet _(#)_.

- Responsible Party for Long-term Maintenance:

Identify the parties responsible for long-term maintenance of the BMPs identified above and Source Controls specified in Attachment B. Include the appropriate written agreement with the entities responsible for O&M in Attachment F. Please see Chapter 5 "Private Ownership and Maintenance" on page 94 of the County SUSMP for appropriate maintenance mechanisms.

Name: T.B.D.
Company Name: Building Owners Association for California Crossings
Phone Number: T.B.D.
Street Address: T.B.D.
City/State/Zip: T.B.D.
Email Address: T.B.D.

- Funding Source:

Provide the funding source or sources for long-term operation and maintenance of each BMP identified above. By certifying the Major SWMP the applicant is certifying that the funding responsibilities have been addressed and will be transferred to future owners.

The County of San Diego identifies biofilters, small detention basins (underground detention), and catch basin inserts as second category improvements; therefore on-going maintenance needs to be assured. With a second category designation, the County needs to make sure private owners maintain the proposed BMPs, and provide the County the ability to step in and perform maintenance if required. The applicant will provide the County with security to back up the maintenance agreement, which will remain in place for an interim

period of five years. The amount of the security will equal the estimated cost of two years of maintenance activities. The security can be a Cash Deposit, Letter of Credit or other form acceptable to the County. For the BMPs for the Harvest Road inlets, a maintenance category 3 was selected since the BMPs will be within the County right-of-way and will therefore be maintained by the County. The applicant will provide the developer fee required to cover the initial maintenance period of 24 months.
The applicant will provide verification of maintenance by a subsequent owner with an acknowledgement of responsibility or other contractual agreement such as a BMP maintenance agreement with easement and covenant. The BOA for California Crossings will be responsible for the long-term maintenance, repair, or replacement of the on-site post-construction BMPs in accordance with the County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance. The underground detention basin will need to be inspected annually and when the sediment level reaches an appropriate depth, it will be cleaned out.

ATTACHMENTS

Please include the following attachments.

ATTACHMENT		COMPLETED	N/A
A	Project Location Map	X	
B	Source Control Exhibit	X	
C	LID and/or TC-BMP Exhibit	X	
D	Drainage Management Area (DMA) Maps, Sizing Design Calculations and BMP/IMP Design Details	X	
E	Geotechnical Certification Sheet		X
F	Maintenance Plan		X (to be completed during final engineering)
G	Tracking Report		X
H	Addendum		X

Note: Attachments B and C may be combined.

ATTACHMENT A

Project Location Map

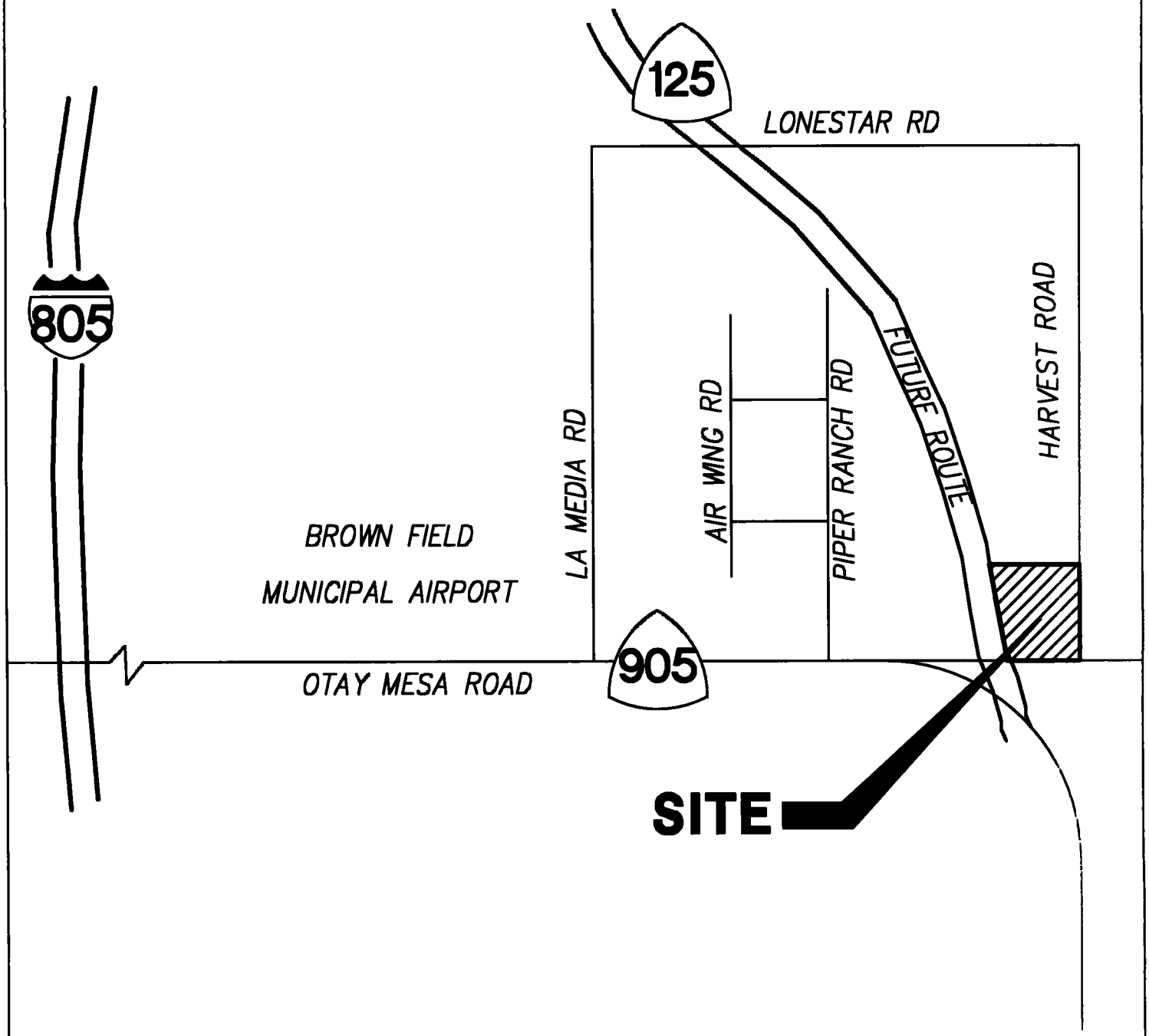


EXHIBIT A
VICINITY MAP

NO SCALE

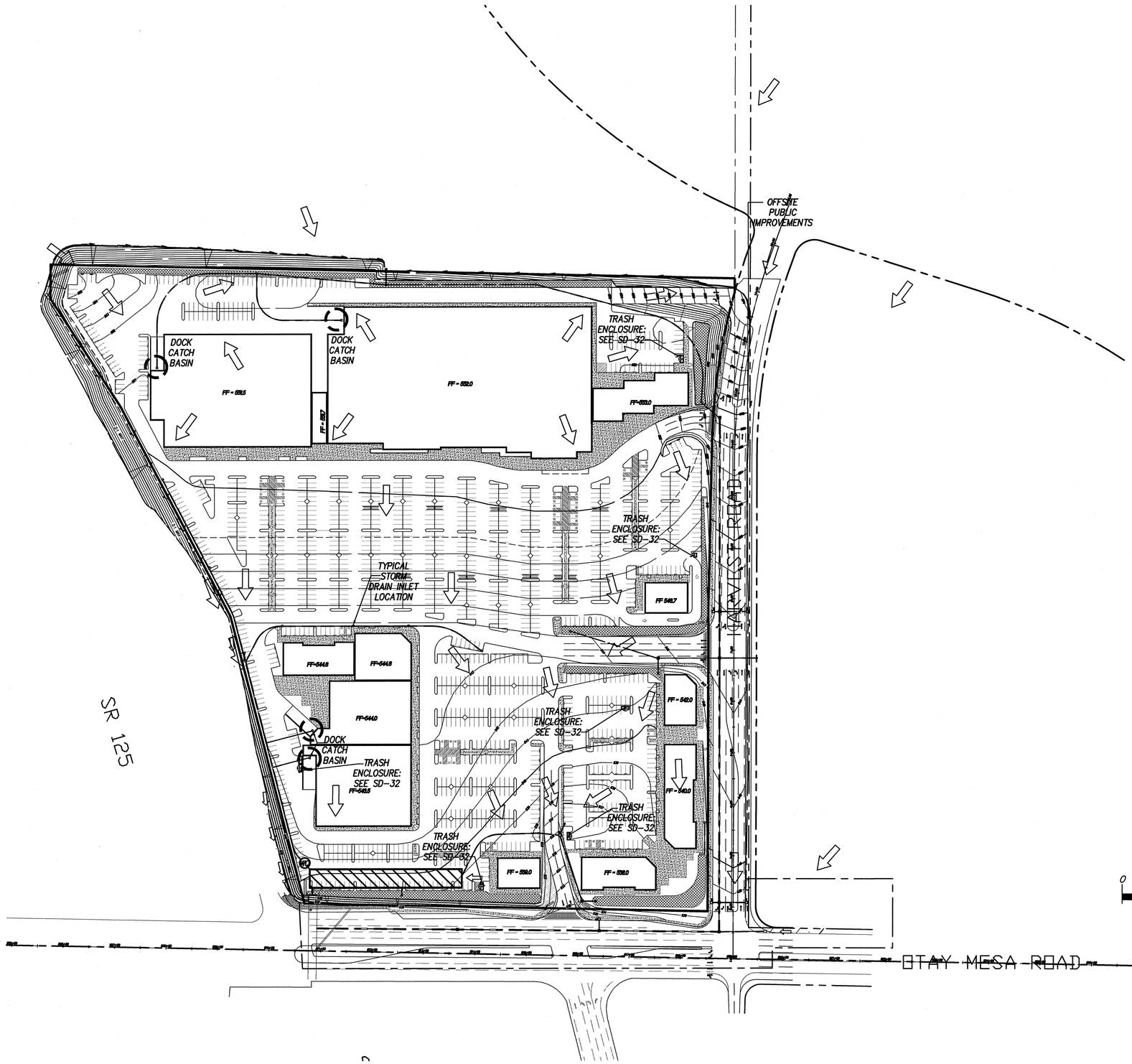
ATTACHMENT B

Source Control Exhibit

SOURCE CONTROL BMP NOTES:

1) FOOD SERVICE CLEAN UP LOCATIONS SHALL BE INTERIOR TO BUILDING(S). DRAIN(S) WILL BE CONNECTED TO A GREASE INTERCEPTOR BEFORE DISCHARGING TO THE SANITARY SEWER

2) DEPRESSED LOADING DOCKS WILL NOT DRAIN DIRECTLY TO THE PUBLIC STORM DRAIN SYSTEM BUT WILL BE TREATED PRIOR TO DISCHARGE FROM THE SITE.



N

0 50 100 200 300

GRAPHICAL SCALE

LEGEND

- FLOW DIRECTION
- UNDERGROUND DETENTION (~1.2 ACFT)
- LOADING DOCK STORM DRAIN INLET LOCATIONS

SCALE:	1"=100'
JOB #:	3315.00
CREATED:	7/28/10

PREPARED BY:

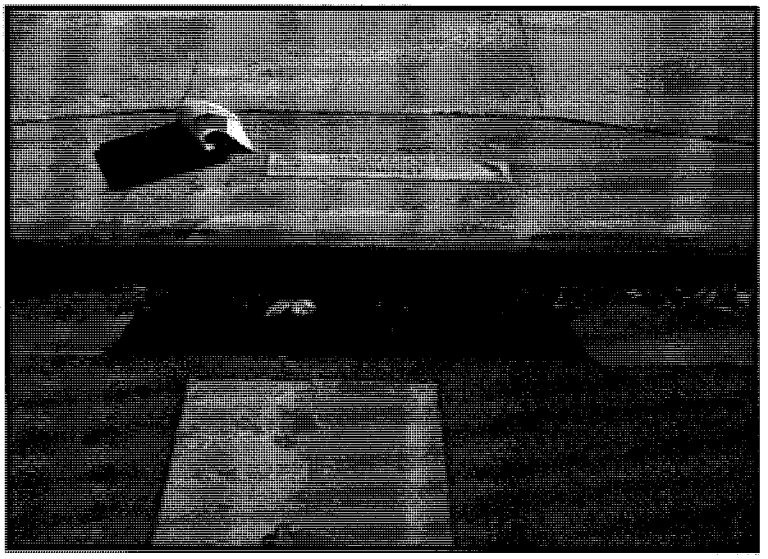
PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Environmental | Engineering | Survey
701 B Street, Suite 800 San Diego, CA 92101
619.235.6471 Tel 619.234.0349 Fax

COUNTY OF SAN DIEGO
CALIFORNIA CROSSINGS

SOURCE CONTROL BMP LOCATION MAP
ATTACHMENT B

LAST SAVED BY: Chelisa Pack, FILE NAME: P:\3315\ENGR\REPORTS\SWMP\Attachments\(B) Source Control BMP Map.dwg, DATE SAVED LAST: 6/28/2010 1:37:24 PM, PLOTTED LAST: 6/28/2010 1:57:19 PM

Storm Drain Signage SD-13



Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

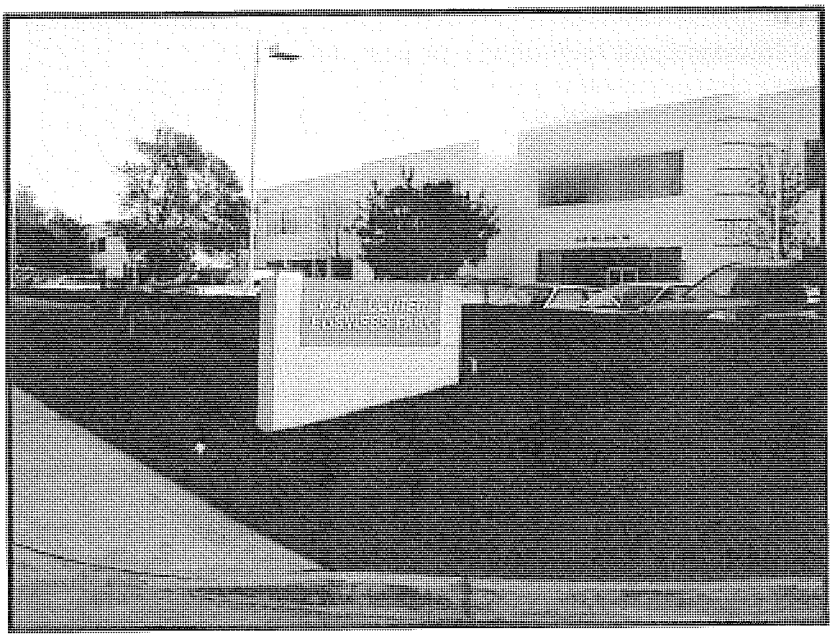
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Building & Grounds Maintenance SC-41



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

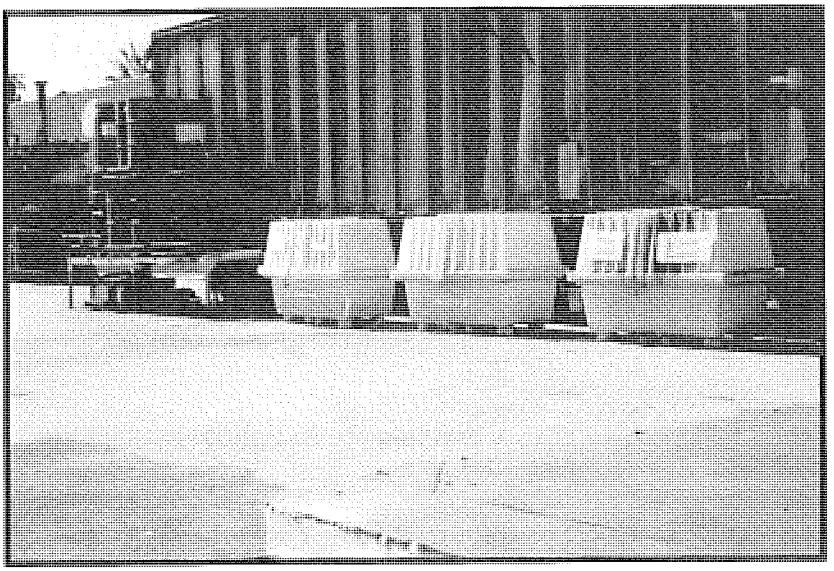
Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Waste Handling & Disposal SC-34



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

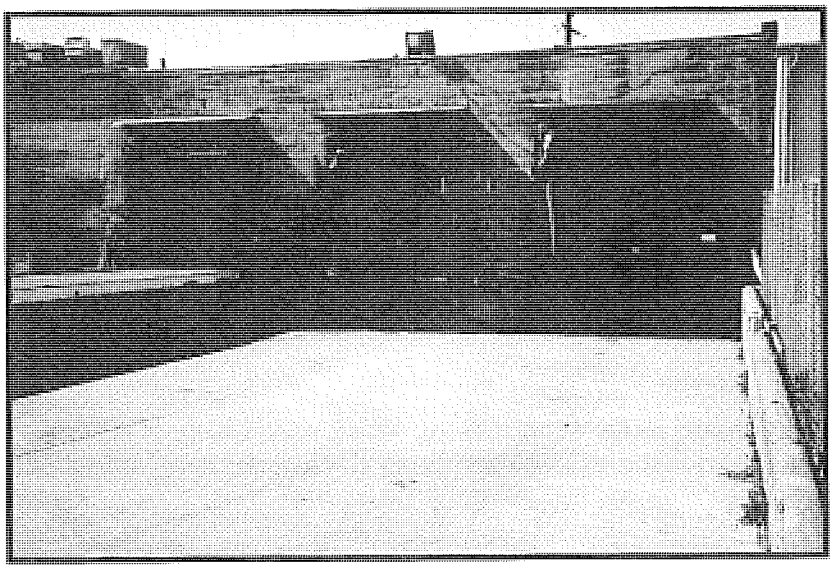
King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Outdoor Loading/Unloading SC-30



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

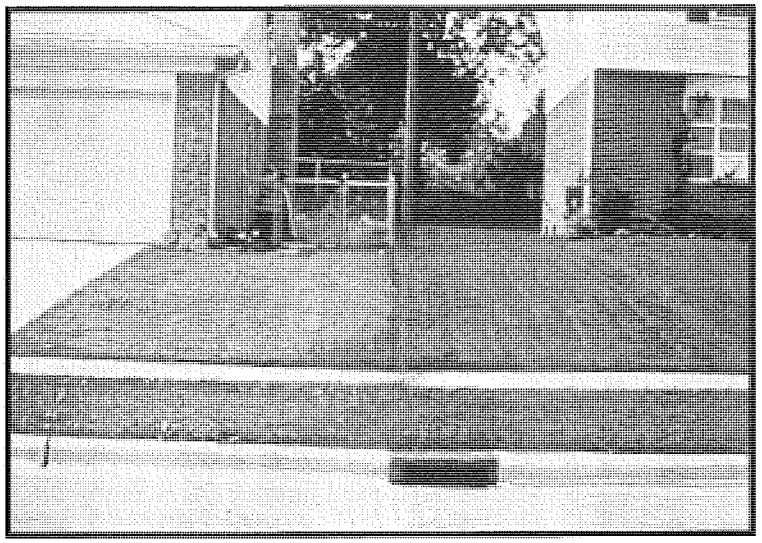
Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Efficient Irrigation SD-12



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

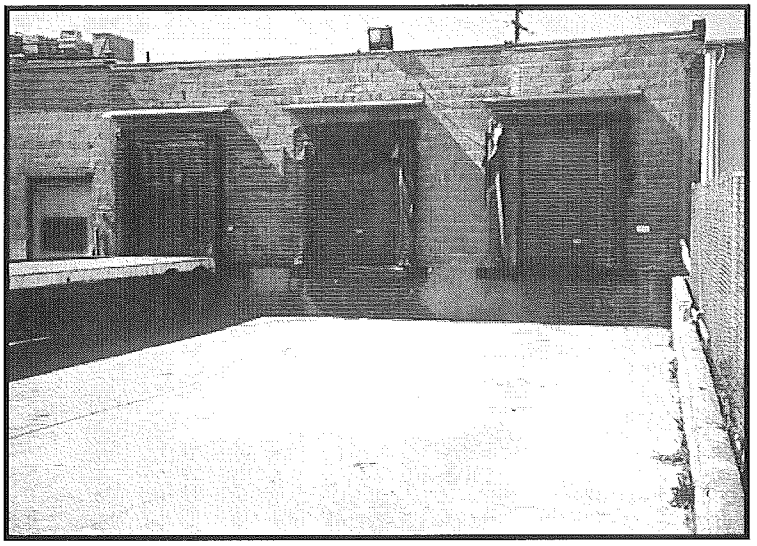
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Maintenance Bays & Docks SD-31



Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

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- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Develop a Stormwater Pollution Prevention Plan (SWPPP)

The development of a Stormwater Pollution Prevention Plan (SWPPP - pronounced "S-W-I-P") is critical in a business' efforts to reduce pollutants in its stormwater discharges. The primary purposes of the SWPPP are to:

- Identification of pollutant-generating activities
- Select and implement BMPs to address these activities
- Review and modification of the plan to ensure effective implementation

BMP Objective

The purpose is to develop a plan that is used by your business to prevent pollutant generation and discharge of the pollutants to the storm drain system.

Implementation

There are many guidelines and templates available for SWPPP development. It is important to understand what is necessary for your business. Some businesses are regulated by agencies and required to develop a SWPPP that contains specific regulatory information. If you are unsure if you need to develop a SWPPP under these regulations, please check with your local jurisdiction (city or county) or at the State of California website: http://www.swrcb.ca.gov/stormwtr/industrial.html

A SWPPP should be customized to fit your business' needs. The following website has guidelines and guide sheets available to help you through the process. http://www.cabmphandbooks.com/Documents/Industrial/Section_2.pdf (see Section 2.4)

IMPORTANT: Use only what you need – it is not necessary to create a plan that does not pertain to your business.

Your businesses SWPPP should:

- Identify pollutant-generating activities (for example - hosing down parking lots, trash areas, drive-thrus, outdoor areas)
- Identify pollutants at your facility that may be discharged to the storm drain system (for example – detergents, grass clippings, fertilizers, pesticides)
- Select and implement BMPs to address these activities and prevent release of pollutants
- Review and modification of the plan to ensure effective implementation

Train Employees

Improper handling of materials and misgiuded activities can allow pollutants to enter sewers and stormwater systems. Such pollution can be prevented and reduced by training staff and conducting activities in safe environments. Staff will be more likely to follow directions if they are also educated about the objectives of best management practices.

BMP Objective

This best management practice is intended to provide guidance to employers on how to motivate staff to follow best management practices.

Implementation

DO:

- Train employees upon hiring and annually thereafter about stormwater discharge prohibitions and spill prevention. Supply them with reference materials and keep a copy of these materials on site.
- Provide all training and materials in the first language of employees.
- Keep training records with date, instructor and attendee information.
- Develop a Stormwater Pollution Prevention Plan (SWPPP) and provide a copy for employee access.
- Maintain information about any toxic chemicals that employees may encounter. This should include whether a chemical is hazardous, flammable, etc. and how to handle spills.
- Choose best management practices appropriate to your business by searching this database.
- Explain the purpose of best management practices and give employees a brief explanation of the consequences of pollution in our waterways. People are more likely to comply with directions if they understand why they are important and how they can personally benefit from keeping our creeks, rivers, and ocean clean.
- Post important safety information where BMPs should be used. Keep spills clean up information with clean up materials near storage areas, for example.
- Make compliance with BMPs convenient. Provide appropriate disposal containers, sufficient working equipment and time at the end of the shift for clean-up, etc.
- Ensure that there are open lines of communication for employees to ask questions. Before training, find out what issues employees wish would be covered.
- Consider what incentives you might give employees for BMP compliance.
- If problems are observed, address corrections and review it with employees. Document the corrections in your stormwater training records.
- Empower employees to suggest ideas for implementing effective best management practices and practical solutions.
- Consider sending employees to seminars to supplement their in-house training. Courses are offered through community workshops and business assistance centers for stormwater issues. www.rebrac.org

DON'T:

- Do not pull staff out of training to deal with business. Make sure time is set aside for training only.
- Do not assume that employees will remember everything from their training. Signs and other quick reminders will help with the orientation process of new employees.

Limitations

Staff time and budget for training materials may be limited. Consider adding BMP training to other standard training to minimize costs.

Clean Floor Mats

Floor mats are often used by restaurant kitchens to provide comfort, safety, and relief to staff members. The floor mats capture droppings (food particles, oils and grease, etc.) and other pollutants such as bacteria and dirt. It is important that floor mats are cleaned properly to ensure that the dirt, food, grease, bacteria and other pollutants don't leave the property and/or enter a storm drain.

BMP Objective

The purpose of the best management practice is to prevent pollutants such as dirt, bacteria, oil and grease from leaving the property and entering the storm drain system or waterways.

Implementation

DO:

- If using toxic detergents or cleaning agents to clean the floor mats, consider non-toxic alternatives – See Use Non-toxic products when possible
- Whenever possible, wash the floor mats indoors into drains that are plumbed to the sanitary sewer system
- Instead of using floor mats, consider using non slip shoes for all employees. This may eliminate the need for floor mats.
- If a sink (such as a mop sink – never in a food preparation sink) is available and is large enough to handle the size of the mat, wash the mat in the sink where the pollutants can be rinsed into the sanitary sewer system where the wastewater will be treated
- If floor drains are available that drain to the sanitary sewer, use a hose to wash the mats and allow the wash and rinse water to drain into the sanitary sewer lines where the pollutants will be treated
- Make sure to dispose of all wash water that contains oil and grease in a grease trap or interceptor
- Utilize a vendor/service that will properly wash your floor mats at their remote facility designed for such purposes
- Use fully launderable mats that can be washed in laundry machines
- If you must wash your floor mats outdoors, then be sure to implement the following practices:
    - NEVER let wash water enter the street, gutter or storm drain
    - Protect downstream inlets
    - Collect wash water and rinse water for disposal into the sanitary sewer system for proper treatment – collection can occur in several ways – two examples follow: using a wet vac to suck up the wash water into a canister for proper disposal into the sanitary sewer; washing the floor mats in a container so that the wash and rinse water is contained and can be disposed of in the sanitary sewer
- If there is limited amounts of oil and grease and food waste, it may be appropriate to wash floor mats in a grassy areas and allow the rinse water to infiltrate into the landscaping

DON'T:

- Don't wash your floor mats outdoors unless proper precautions are taken (see above)
- Don't pour wash or rinse water outside or into a street, gutter or storm drain

Clean Sewer Lines - Food Service

Business owners are responsible for cleaning and maintaining sewer pipes that run from their facility to the main sewer line. If pipes become blocked, the facility's own sewage may overflow. An overflow will force a food service establishment (FSE) to shut down to protect public health until the site can be cleaned. Generally, FSE sewer lines become plugged with the accumulation of fats, oils and grease (FOG). To prevent clogs and overflows, properly maintain a grease trap and use the BMPs referenced here. Drain cleaners and other chemicals should not be poured down the drain without first checking with the sewer authority as they can be toxic to humans and aquatic life once in local waterways.

Implementation

DO:

- Consider a professional inspection and cleaning. The older the facility, the more likely your pipes may be in need of some repair. Moisture from small leaks in underground pipes attracts roots which can cause further damage. Look for "plumbing contractors" in the yellow pages. A contractor can clean sewer lines and remove any obstructing roots.
- Properly Dispose of Oil and Grease to avoid clogs. Whether or not fats, oils and grease (FOG) enter the drain as a liquid, they harden downstream. FOG accumulates in pipes like cholesterol in an artery and buildup can block laterals. This BMP explains how to maintain a grease trap to keep grease out of sewer lines.
- Conduct Activities in Designated Areas Dishes should not be washed in vegetable sinks, for example, as the sinks are usually not connected to the grease trap.
- Locate your lateral with survey documents. Your lateral is the main pipe that runs from your facility to the street. You probably received survey documents when you purchased your business and they will indicate the lateral location. If you do not have these, your city planning or public works department at http://www.sdcounty.ca.gov/dpw/ can provide them for view.
- Prevent roots from entering your lateral. Once you have located your lateral, landscape so that roots from tree and shrubs can't reach it. Choose varieties that do not have shallow, spreading roots. Roots seek out the water and nutrients available in sewer lines and can grow into pipes and block them. Problem trees include poplars, willows, figs, rubber trees, large eucalyptus trees, fruitless mulberry and the Modesto ash. For more information visit http://www.sewersmart.org/prevention-4.html.

DON'T:

- Do not wait for a sewer overflow before you have your lateral and grease trap inspected and cleaned. A sewer overflow will shut down your business until sanitary conditions are restored. An overflow reaching the storm drain is illegal and may result in enforcement action, including fines. Schedule routine maintenance as part of your ongoing facility maintenance. Clean up of an overflow will be much more expensive than an inspection and routine cleaning.
- Do not use chemicals to unclog drains or digesters to break down grease without first checking with your local sewer authority. Chemicals in these products can be toxic to humans and aquatic life.
- Do not wash oil, grease, and solids on the floor into floor drains. Instead, Clean Up Regularly with Dry Methods and Properly Collect and Dispose of Wash Water.

Clean Up Regularly Using Dry Methods

Dry clean up methods should be used both inside and outside of facilities. Inside, dry clean up should be used for oil and grease spills as well as general floor cleaning. Outside, keeping sidewalks, parking lots and other paved surfaces around the facility clean can help keep our waterways clean too. When it rains, trash, dirt, and chemicals that have built up on these surface can run into the street and eventually the storm drain. Sweep up these areas instead of hosing them down and you can put dirt and trash into the garbage, instead of into the storm drain.

BMP Objective

This best management practice is intended to keep oil, grease, and solids out of the sewer, as well as dirt, debris, and toxic chemicals out of the storm drain system.

Implementation

- Inside or outside, Contain and Clean Up Spills with dry methods. Oil and grease, as well as chemicals can be contained with rags or absorbents such as kitty litter. Cleaning chemicals with water just adds to the waste they may have to be disposed of with a professional hauler. Water containing oil and grease will have to be discharged to the grease trap, which will increase the frequency and consequently the cost of trap cleaning.
- In restaurants, use paper towels to clean up small oil and grease spills because rinsing cloth rags will send oil and grease down the drain Or consider using a laundry service for towels, rags and mop heads
- Use dry methods to clean floors. Then, only if necessary and if wash water will stay on the property, spot clean with a mop. Follow this process:

  1) Clean small spills with rags and larger spills with absorbent materials such as kitty litter.
  2) Sweep floor using dry absorbent material.
  3) Mop the floor and Properly Collect and Dispose of Wash Water.

- If absorbent is used to clean up hazardous waste, it must be disposed of as hazardous waste. If it is used to clean up non-toxic spills such as cooking oil, it should be sealed in a plastic bag and put in the garbage.
- Use a professional laundry service to clean shop rags. Professional laundries are equipped to handle wash water that contains oil. Look for major uniform laundry services in the phone book; many also wash shop rags.
- To clean up oil on floors, you may also use an oleophilic mop (picks up oil and not water). This will reduce the volume of waste liquids and oils you collect and reduce your cost of disposal. Google search "oil mops". (These mops are not intended for food grade oils, mops will grow bacteria.)
- Sweep sidewalks, parking lots and other surfaces regularly instead of hosing them down. Water may wash motor oil, automotive fluids, fertilizer and pesticides from landscaping, leaves, trash, and dirt into the storm drain. Keep the rain from washing pollutants away by sweeping often and keeping these surfaces clean. Collect sweepings in a dust pan and put them in the garbage.
- Make sure that when garden areas around the facility are maintained, lawn clippings and dirt are swept back into the garden.
- Consider leaving fallen leaves in landscaped areas as mulch, or dispose of them as green waste.

Conduct Activity in Designated Areas - Food Service

Food service establishments conduct numerous activities in various locations. In some instances, the areas are exposed and are not appropriate for the activities. Pollutants associated with the activities can leave the area and enter the storm drain system causing the pollutants to enter the creeks, lagoons and the ocean. It is important to designate specific areas that are appropriate for the activities.

BMP Objective

The purpose of this best management practice is to prevent pollutants from leaving the property - especially into the street or storm drain system.

Implementation

DO:

- Post "No Grease" signs on dishwasher and sinks not connected to grease traps.
- Designate areas for activities that will NOT produce grease and post signs. Labeling the vegetable washing sink, for example, will encourage employees to use sinks that might not be connected to the grease trap appropriately. This will free up sinks that are plumbed to the grease trap for activities that do generate grease, such as dish washing.
- Wash dishware in a three-compartment sink. Use the first compartment for scrubbing with a detergent, the second compartment for a hot rinse, and the last compartment for sanitization with a bleach solution. Water should be less than 140 degrees Fahrenheit. All sinks should have a strainer to catch food scraps.
- Properly Store and Contain Oil and Grease. Store oil rendering containers inside, or if stored outside, seal container with a tight lid. Keep containers closed when not adding or removing waste.
- Locate outdoor oil and grease containers away from storm drains. The greater the distance between the two, the more time someone has to clean up a leak or spill before it reaches the storm drain.
- Immediately clean up oil spills and drips as soon as they occur.
- Label Storm Drain Inlets and drains that pass through a grease trap or directly to the sewer.
- Properly Clean Floor Mats. Where possible, wash mats in a sink plumbed to the grease trap. Do not hose down mats to the street or a storm drain.

DON'T:

- Never pour oil and grease into a storm drain or the garbage.
- Do not hose down work areas to a storm drain. Clean Up Regularly with Dry Methods.

Conduct Activities Over Pervious Areas - Food Service

Preventing runoff from properties is an important pollution prevention activity. When water leaves a property, often times it will carry with it pollutants from the property. Also, when the water drains towards a storm drain, it will pickup pollutants along its path, carrying more pollutants to the storm drain, creeks, rivers, lagoons and the ocean. Restaurants and other food service establishments often conduct outdoor activities that involve the use of water, including cleaning floor mats and washing out tubs or other containers.

BMP Objective

Prevent runoff from the site by infiltrating the water into the ground.

Implementation

To implement this best management practice is to first identify the activities that are performed outdoors that involve the use of water. These activities could include; rinsing wash buckets, washing floor mats, washing other equipment, washing trash containers, etc. The second thing to do is identify pervious areas where these activities could be performed. Pervious areas are where the water has the opportunity to infiltrate into the ground, for example grassy areas or landscaped areas. Dirt areas must be used with caution – too much water on dirt areas can cause erosion to occur and the dirt or sediment to leave the site as a pollutant itself,

NOTE: This best management practice should not be used for washing hazardous materials outdoors – including acids, oils, grease, and solvents.

When conducting the activity over the pervious areas, it is important to prevent the water from leaving the area and running off onto the parking lot, street, sidewalks, etc. where it can end up draining to the storm drain system. So, be careful to monitor how much water is being used in the area to prevent this runoff.

An alternative best management practice would be to conduct the activity in an area that is controlled – in other words, the water cannot runoff the property or into a storm drain. This is done by conducting the activity indoors, within a secondary containment area, e.g., in a controlled area that is designed to hold the water.

Limitations

If there are no pervious areas around the facility, it is important to conduct the activities indoors OR by properly collecting and disposing of the wash water – see Properly Collecting and Disposing Wash Water.

Contain and Clean Up Spills

There are many activities that have the potential to cause accidental or illegal spills. Proper training and actions can minimize the amount of pollutant discharge to the environment. Activities that have the potential to cause spills include grease handling, waste management, loading and unloading of materials and chemicals.

BMP Objective

The purpose of this best management practice is to prevent spilled pollutants from leaving a property and entering the parking lot, street and/or storm drain system.

Implementation

One of the most important activities to have a plan. The plan should:

- Identify the potential spill areas and activities
- Specify material handling procedures
- Describe spill response procedures
- Provide for spill clean-up equipment and materials

Purchase and maintain spill cleanup materials where it will be readily accessible in the event of spills. In the event of a spill, clean up the spill immediately. Use dry cleaning methods if possible – this includes, absorbents (kitty litter, other commercial absorbents – see below), brooms, dustpans, shovels, sweepers, etc. Spread the absorbents on the spill and allow the material to soak up the spilled liquids. Use a broom, shovel or sweeper to sweep up the material and dispose of properly in a trash can.

If water is used, use as little as possible. Use rags for smaller spills and absorbent materials for larger spills. If the material is hazardous, contact the appropriate reporting agency and take appropriate cleanup and disposal actions.

Limitations

Hazardous material should be cleaned up and disposed of properly by a professional – contact your local agency for specific requirements.

Proper Disposal of Household Hazardous Waste

Household Hazardous Waste (HHW) is any unwanted product that is labeled DANGER, WARNING, CAUTION, POISON, TOXIC, FLAMMABLE, CORROSIVE, REACTIVE, or EXPLOSIVE. Some common items that are considered HHW are:

- Aerosols
- Batteries (auto, household, rechargeable)
- Fertilizers
- Household Cleaners
- Motor Oil and Oil Filters
- Pesticides
- Propane
- Automotive Fluids
- CRTs (cathode ray tubes, TVs and monitors)
- Fluorescent Lights
- Mercury Items (some thermometers)
- Paint and Stains (latex and oil)
- Pool Chemicals
- Solvents

When these items are not properly disposed of, they can release toxic or poisonous pollutants to the environment. These products can cause illnesses and disease among humans, animals and plants.

There are designated disposal sites where the HHW materials can be properly disposed of and processed in a manner that prevents the toxic or poisonous materials from entering the environment.

BMP Objective

The purpose of this best management practice is to prevent hazardous wastes from entering the waterways – including storm drains, creeks, rivers, lagoons and the ocean.

Implementation

DO NOT Pour HHW products down the drain, on the ground or into storm drains. It is illegal and improper to put these products in the trash as well.

Each City has designated HHW disposal sites – call the numbers below to locate the nearest HHW disposal sites.

City of San Diego 858-694-7000
Chula Vista 619-691-5122
Del Mar 800-714-1195
Encinitas 800-714-1195
Imperial Beach 619-691-5122
Lemon Grove 800-449-7587
Oceanside 760-439-2824
San Marcos760-744-1050
Solana Beach 800-714-1195
Carlsbad 800-714-1195
Coronado 619-522-7383
El Cajon 619-596-5100
Escondido 760-839-4818
La Mesa 619-287-5696 x4270
National City 619-691-5122
Poway 800-714-1195
Santee 619-596-5100
Vista 800-714-1195

Safely transport your HHW materials to the proper disposal sites – call ahead for hours of operation and to see if there are limitations on quantities and types of materials accepted.

When transporting HHW materials – keep them in closed, leak-proof containers to prevent spills and mixing of chemicals. The containers should be no larger than 5 gallons and placed in the trunk away from passengers and pets.

Proper Materials Storage

Proper storage of materials can range from sealing chemicals in a well-labeled container indoors to covering piles of materials outdoors. Hazardous materials require special attention, but non-hazardous materials also need to be stored so that they do not contribute to dirt, trash, and debris in stormwater. Designate a storage area where runoff will not lead to the street or storm drains. Minimize mishandling by training staff and posting applicable pollution prevention information in storage areas.

BMP Objective

The purpose of this best management practice is to minimize leaks, spills, and runoff that may might pollute stormwater.

Implementation

DO:

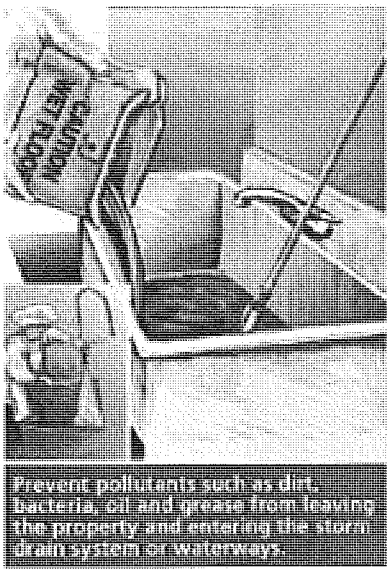
- The first step in properly storing materials is to compile a materials inventory by reviewing purchase orders and touring the physical plant or work area of your business.
- Identify chemicals that are hazardous or toxic. Maintain Material Safety Data Sheets (MSDS) and other safety material for stored inventory in an area accessible to employees. Include information on safety equipment and appropriate materials and procedures to clean spills. In some cases, posters in storage areas may be the best way to remind employees of this information when it is needed. Provide all materials in the first language of employees.
- Keep applicable clean up kits where materials are stored.
- Label stored materials for contents, unit number, expiration date, handling instructions, and health or environmental hazards.
- Store materials where runoff will not lead to the street, gutter, or storm drain. Storage areas should be graded so that runoff will not lead to storm drains or stored materials can be lifted away from the runoff, for example, by storing on pallets and then covering with a tarp.
- Close off drains in storage areas.
- Provide Secondary Containment. This provides a backup in case of leaks or spills.
- If possible, store materials indoors. This prevents wind and rain from carrying them away.
- Outdoors, cover any materials that are toxic or could contribute to trash, debris, and sediment in stormwater. For example, use leak proof lids on containers or plastic tarps over dirt piles. If they are exposed to runoff, they should also be isolated by either using berms, or elevated, for example, by using pallets.
- Keep in mind the lifespan of the cover used. Tarps and plastic sheets, for example, may not hold up well in certain climates.
- For dirt piles, block rainwater runoff with a Berm.
- In storage areas, Clean Up Regularly with Dry Methods.
- Keep dumpster lids closed and consider constructing a roof or overhang to shelter the dumpster. Replace leaking dumpsters.
- Take care when loading and unloading materials to minimize losses or fugitive emission losses such as dust or mist.

DON'T:

- Do not dispose of unwanted materials in the street or storm drain.
- Do not assume that a material is safe for stormwater because it says it is non-toxic or biodegradable. Non-toxic means the product is not toxic to the user. Biodegradable means the product will eventually break down, but it may harm the environment in the meantime.

Properly Collect and Dispose of Wash Water - Food Service

Water is often used to clean the outdoor areas of restaurants. Primarily water is used to clean floor mats, sidewalks, drive-thru areas, wash windows, and clean buildings and roofs. It is important to prevent the wash or rinse water from leaving the property and entering into the storm drain system. The wash water may contain detergents, chemicals and other pollutants that will make their way to the creeks, lagoons and ocean. The water used may be from hoses, mop buckets or other containers used by the restaurant.



BMP Objective

The purpose of this best management practice is to prevent wash water (or any non-rainwater) from leaving a property and entering the street and/or storm drain system.

Implementation

DO:

- First, ask the question - "Do I/we need to clean this area or conduct this activity with water?" It is much better for the environment to use dry sweep methods to clean outdoor areas (see "Clean up regularly with dry cleanup methods")
- Sweep or vacuum the area to remove bulk litter and debris.
- If the use of water is necessary, consider using a mop and bucket system that doesn't require the use of a hose. The bucket water still needs to be disposed of in a sink or toilet (sanitary sewer system)
- If wash water is necessary, direct the water to a vegetated area using portable berms or sand bags. Any residual litter must be removed from the vegetated area.
- If wash water outdoors must be used, locate the storm drain that takes water from your property, even if it is off your property and in the street; protect the storm drain by employing the methods described below (for more information see BMP "Protect storm drain inlets")
- Cover the storm drain inlet with a plastic sheet that will not allow water into the storm drain and will "pond" the water
- Place a weighted object (like a sandbag or other weighted bag) on the plastic sheet to prevent it from moving with wind or water and to create a tight seal with the ground or pavement to keep water from getting around the sheet to the inlet
- Vacuum up standing water before removing drain inlet protection.
- BE SURE TO REMOVE THIS INLET PROTECTION WHEN COMPLETED - OTHERWISE FLOODING MAY OCCUR
- Sweep up the path between the area where water will be used and the storm drain inlet to prevent the leaves and/or debris from washing into the storm drain. Dispose of sweepings in a trash can.
- Conduct activity (washing mats, washing windows, cleaning sidewalks, washing drive-thrus, etc.)
- Use a wet-vac (vacuum that can suck up water) and vacuum the wash water, then dispose of the water to a sanitary sewer connection.
- Pour the wash water into the sanitary sewer system (toilet or sink) being careful not to put anything hazardous, toxic or that can clog the sink or toilet into the system.
- If not harmful to plants, the water may be poured into landscaping areas in amounts that will not cause the water to leave the landscaped areas.

DON'T:

- Do not dump any water into the storm drain system
- Do not dump the water into the street, parking lot or other area where the water will drain towards the

Properly Collect and Dispose of Wash Water - Power Washing

Water is discharged from high pressure washing systems during power washing activities. It is important to prevent the water from leaving the property and/or entering into the storm drain system. The water may contain pollutants that will make their way to the creeks, lagoons and ocean.

BMP Objective

The purpose of this best management practice is to prevent discharge water from power washing (or any non-rainwater) from leaving a property and entering the street and/or storm drain system.

Implementation

DO:

- Sweep or vacuum the area to remove bulk litter and debris.
- Direct the water to a vegetated area using portable berms or sand bags. Any residual litter must be removed from the vegetated area.
- Protect the storm drain by employing the methods described below (for more information see BMP "Protect storm drain inlets")
- Cover the storm drain inlet with a plastic sheet that will not allow water into the storm drain and will "pond" the water
- Place a weighted object (like a sandbag or other weighted bag) on the plastic sheet to prevent it from moving with wind or water and to create a tight seal with the ground or pavement to keep water from getting around the sheet to the inlet
- Vacuum up standing water before removing drain inlet protection.
- BE SURE TO REMOVE THIS INLET PROTECTION WHEN COMPLETED - OTHERWISE FLOODING MAY OCCUR
- Sweep up the path between the area where water will be used and the storm drain inlet to prevent the leaves and/or debris from washing into the storm drain. Dispose of sweepings in a trash can.
- Use a wet-vac (vacuum that can suck up water) and vacuum the wash water, then dispose of the water to a sanitary sewer connection.
- Pour the water into the sanitary sewer system (toilet or sink) being careful not to put anything hazardous, toxic or that can clog the sink or toilet into the system.
- If not harmful to plants, the water may be poured into landscaping areas in amounts that will not cause the water to leave the landscaped areas.

DON'Ts

- Do not dump any water into the storm drain system
- Do not dump the water into the street, parking lot or other area where the water will drain towards the storm drain system.

Properly Handle Solid Waste

Businesses and property owners should consider their management of both litter and solid waste. Separating solid waste can minimize the amount of waste that requires paid disposal. It also allows possible pollutants to be properly contained. In some cases garbage may leak and introduce toxic pollutants to rainwater runoff. Trash itself is increasingly becoming a pollutant in runoff, eventually littering waterways with trash and harming aquatic life. Animals may mistake some trash as food and become tangled or swallow harmful materials.

BMP Objective

The purpose of this best management practice is to keep garbage out of waterways and prevent leaks from garbage containers from introducing other pollutants to rainwater runoff.

Implementation

DO:

- First, segregate wastes into these categories:
- Reusable materials: Consider what might be reused by you, your businesses or others. Some construction wastes can be reused, for example, at a lower cost than landfilling.
- Recyclables: This goes beyond plastic containers and glass to automotive fluids and yellow grease. Often talking to material suppliers will help you locate recycling facilities. San Diego County-specific information on reuse and recycling is available at http://www.sdcounty.ca.gov/dpw/recycling/commercial.html.
- Green waste: Keep green waste clean by not mixing it with other garbage. The cost of disposing of green waste is lower than general landfill costs. In communities with curbside pickup of yard wastes, place clippings and pruning waste at the curb in approved bags or containers. For commercial disposal of green waste visit: http://www.co.san-diego.ca.us/dpw/recycling/pdf/GreenWasteRecyclingGuide.pdf
- Waste that may be composted: Depending on the user, this may or may not be appropriate. Landscapers, for example, can start composting piles for clients. Meat and greasy food scraps should not be added to compost piles. Other food scraps are able to be composted.
- Oil and Grease: Properly Contain and Store Oil and Grease (Food Service or Auto Facilities)in sealed waterproof containers, and Properly Dispose of Oil and Grease (Food Service, Auto Facilities or Residential). If the oil and grease is stored outside, ensure the container and surrounding area is kept clean using dry methods and that the lid is kept shut when not in use.
- Garbage: Do not put hazardous waste in the garbage.
- Hazardous waste: See Proper Disposal of HHW Materials. Provide Secondary Containment.
- Electronic waste: TVs, computer monitors and batteries are no longer allowed to go to the landfill. Contact your local household hazardous waste program for recycling options for these items.
- Fluorescent tubes: Fluorescent light tubes contain mercury. These lights should be collected for recycling to prevent the discharge of mercury into landfills and the environment.
- Collect and cover green waste with a tarp to prevent rain from washing debris into storm drains. Keep piles away from storm drain inlets. Consider using a Berm.
- Pick up litter on your property or at your work site. If litter is a persistent problem, post no littering signs and provide adequate garbage cans with lids on the property.
- For dumpsters,
- Keep trash container lids closed and consider constructing an overhang above the dumpster to further protect it from rain.
- If your dumpster leaks, contact your solid waste hauler to have it repaired or replaced.
- Sweep areas around dumpster to collect any litter.

Properly Store and Contain Oil and Grease - Food Service

Fats, oil, and grease (FOG) from food service establishments should be separated according to type and stored in sealed containers. Appropriate storage will prevent leaks and spills which could run directly to the sanitary sewer or a storm drain. Not only is a discharge to the storm drain illegal, if oil and grease enter our waterways, they provide nutrients which cause an overgrowth of algae called algae blooms. Algae blooms then die off rapidly and reduce the amount of oxygen in water which consequently can kill aquatic life.

BMP Objective

This best management practice is intended to prevent oil and grease from entering the sanitary sewer or the storm drain system.

Implementation

DO:

- Conduct Activities in Designated Areas. Dishes and cooking equipment should only be washed in sinks connected to the grease trap.
- Collect fryer oil in an oil rendering tank instead of discharging it to the grease trap. For a list of locations or services for disposing of grease see http://www.calfog.org/Hauler.html.
- Scrape meat fat and cooking oils into a tallow bin or sealed container with a tamperproof lid. This is yellow grease and may be recycled if it is not contaminated with other waste. For a list of locations or services for disposing of grease see http://www.calfog.org/Hauler.html.
- Store oil containers indoors or isolated from rain and runoff. This can be under cover or in an enclosure.
- Ensure employees are trained to properly dispose of grease and oil to minimize spillage and to ensure the bin is closed when not in use.
- Routinely clean grease bins and the surrounding area, especially when it is stored outside.
- If oil spills occur, clean them up immediately to prevent tracking or spreading.
- Keep containers closed except when adding or removing the waste.
- Store containers away from storm drains and use secondary containment.
- Contact your oil and grease hauler to replace leaking or damaged tallow bins.

DON'T:

- Do not use hot water or soap to wash FOG down the drain. Properly Dispose of Oil and Grease.
- Never pour FOG into the storm drain and minimize FOG entering the sanitary sewer that is not plumbed through the grease trap. Dumping in storm drains is illegal. If you see this happening in the County of San Diego call 1-888-846-0800.
- Do not connect your dishwasher to the grease trap. Hot water from the dishwasher will cause grease to pass through the grease trap. Instead, rinse dishes before putting them through the dishwasher.

Properly Dispose of Oil and Grease - Food Service

Fats, oil, and grease (FOG) should not go down a storm drain, the toilet, or any drain not connected to a grease trap. Whether or not FOG enters the drain as a liquid, it hardens downstream. FOG accumulates in pipes like cholesterol in an artery and buildup can cause overflows. Overflows into a food service establishment will result in a shut down to protect the public health.

BMP Objective

This best management practice is intended to prevent oil and grease from entering the sanitary sewer or the storm drain system.

Implementation

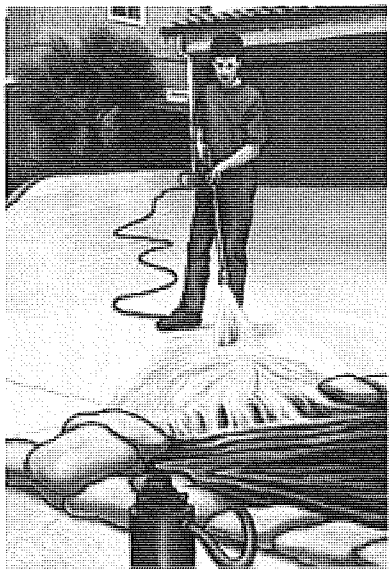
DO:

- Scrape meat fat and cooking oils into a tallow bin or sealed container with a tamper proof lid. This is yellow grease and may be recycled if it is not contaminated with other waste. See Properly Store and Contain Oil and Grease. For a list of locations or services for disposing of grease see http://www.calfog.org/Hauler.html.
- If it's a small quantity of FOG and it will harden, put it in an old milk carton, coffee can, or any container that will seal and not break.
- If it is a small quantity of FOG and it is liquid, put it a larger container with a lid and add an absorbent until it is completely absorbed. Examples of absorbents include kitty litter, shredded newspaper, napkins, and paper towels.
- Dispose of food scraps as either compost waste or garbage.
- Maintain a grease trap. First of all, have a professional determine whether the grease trap is an appropriate size. If the trap is too small, grease may pass through it. Oversized traps may become stagnant and cause corrosive conditions. Ask the professional how you will know when your grease trap needs to be cleaned.
- Regularly inspect and clean the grease trap. With most traps, a professional should pump the top grease layer out of the grease trap as well as pumping out sediments on the bottom. See "grease trap" in the phone book to find these services. For a guide on how to clean a small grease trap yourself see http://www.calfog.org/images/TrapCleaningMtryCo.jpg.
- Properly Clean Floor Mats. Don't hose mats off into the storm drain. Instead, wash them in a sink plumbed to the grease trap.
- Contain and Clean Up Spills of FOG. Wipe up small spills with paper towels and use an absorbent such as kitty litter for larger spills.
- Clean Up Regularly with Dry Methods before washing floors. This will minimize the oil and grease in the wash water. Routinely clean grease bins and the surrounding area when they are kept outside, using dry methods. Ensure the bin lids are kept closed when not in use and encourage employees to reduce spillage of grease and oil as much as possible.
- Train employees to properly clean grills, pans and greasy equipment safely.
- Make sure that your tallow bin is not exposed to rain water, by using the bin lid, keeping it under a roof, and ensuring that the bin area and the area leading to it are kept free of spills. Make sure that your waste vendor also uses Best Management Practices to prevent spills of oil and grease

DON'T:

- Never pour FOG into the storm drain or any connection to the sanitary sewer that is not plumbed through the grease trap. Dumping in storm drains is illegal. If you see this happening in the County of San Diego call 1-888-846-0800.
- Do not pour FOG directly into the garbage.

Protect Storm Drain Inlets - Food Service



Storm drains are a direct connection to the creeks, bays, lagoons and beaches. It is very important to prevent pollutants from entering the storm drain. The pollutants most commonly found entering the storm drain system are leaves and debris, sediment, trash and litter, and wash down pollutants from cleaning activities (soaps and detergents). In order to prevent these pollutants from entering the storm drain, it is important to protect the storm drain inlets while performing activities. Protection includes preventing waters from entering the storm drain system, even if the water appears to be clean.

BMP Objective

The objective of protecting storm drain inlets is to prevent pollutants from entering the storm drain inlets and transporting downstream to the creeks, lagoons, bays and ocean.

Implementation

When you are engaging in an activity where debris or water is generated, the first course of action in protecting storm drain inlets is to locate where the debris or water will go. In almost all cases, water will flow to a storm drain inlet. Even if the inlet is blocks away, it is important to protect that inlet and prevent waters and pollutants from entering it. Everything that goes into the storm drain inlet, will flow downstream to a creek, bay, lagoon and the beaches.

The next step is to determine how you will protect the storm drain inlet. The most commonly used method is to obtain sand bags from your local hardware store. Fill the bags approximately ¾ full with play sand and place around the opening of the inlet to create a berm that prevents water from flowing into the inlet. If possible, use the bags to create a water tight seal that prevents any water from seeping under the bags into the inlet. It may take up to 6 -8 bags to properly protect the inlet. It is important not to place the bags too close to the inlet opening, in case one should fall into the storm drain system. Also, be sure to use bags that are in good working condition, a deteriorating sand bag can break and allow the sand or gravel to flow into the storm drain system.

It is also important to capture as much of the water from your activity as close to the activity as possible. For example, if you are washing down a drive-thru area or trash area, use the sand bags closer to your activity to create dams along the waters path to the storm drain inlet. This allows you to use a wet vacuum to collect the waters (and pollutants) for proper disposal. Any collected waters should be disposed of in the sanitary sewer system (mop sink, toilet, etc.) or in landscaped areas where the water will not runoff into the street or storm drain system.

The most important concept in protecting storm drain inlets is to prevent anything other than rainwater entering the inlet. Other waters, trash and debris must be collected and disposed of properly.

Limitations

It is important to create a water tight seal around the storm drain inlet to prevent any water from seeping past the bags or other berm material. If water seeps past, it will likely continue to carry the pollutants to the creeks; bays; lagoons and beaches.

Label Storm Drain Inlets

AWARENESS - is a key element in getting employees and the public to change their behavior. Providing notifications on storm drain inlets will make people aware that the storm drain delivers what drains into it directly to the creeks, beaches and the ocean. Labeling can come in the form of painting a message or by adhering a tile directly to the inlet - both labeling methods provide the same result: a message that the storm drain leads to the creeks, beaches and ocean.

BMP Objective

The objective of labeling storm drain inlets is to prevent people from pouring things into the storm drain or allowing non-rainwater from entering the storm drain system.

Implementation

The first step to labeling storm drain inlets is to locate all inlets that are on your property. If there are inlets that your property drains to but are in the street or City's right-of-way, it is important that you contact your local jurisdiction prior to labeling the inlet. Many jurisdictions have standard markings that they require for inlet labeling.

If you are stenciling the inlet - obtain the proper stencil, tape the stencil down and paint the markings onto the inlet.

If you are adhering a placard - obtain the proper adhesive; clean the surface with wire brush and sweep dust away; apply the adhesive per the manufacturer's requirements and stick the placard onto the appropriate surface.

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a property. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side.

Irrigation Controllers - Business

New irrigation controllers are available that monitor "real-time" weather data that includes solar radiation, temperature, wind and humidity through hourly downloads.

BMP Objective

The purpose of this best management practice is to utilize a "smart-irrigation" controller for the purposes of water conservation and to prevent over-watering that leads to water discharging from the landscape areas to the storm drain system.

Implementation

Many manufacturers produce the weather sensitive irrigation controllers. Often times, local water agencies offer rebates for particular models and areas – see http://www.sdcwa.org/manage/conservation-overview.phtml#landscapeassistance for more information on rebates and manufacturers.

The controllers can be purchased at home improvement stores as well as via the internet. Once you have purchased one, follow the detailed instructions for setup and configuration.

Be sure to monitor your system to ensure proper functioning, especially under varying weather conditions.

The use of new irrigation controller technology can reduce the amount of over-watering that is very common for homeowners, property managers and landscapers. Over-watering can lead to water leaving the landscaped areas, carrying pollutants to the sidewalks, streets, storm drains and eventually to the creeks, rivers, lagoons and the Pacific Ocean.

Limitations

The weather sensitive or "smart" irrigation controller is useful for controlling the amount of water that is used by the irrigation system. It is equally important to control the location of where the water is sprayed for irrigation. If water is sprayed onto impervious surfaces, like sidewalks, streets or parking lots, the water will runoff and carry pollutants to the storm drain system. See the Irrigation System Maintenance.

Irrigation System Maintenance - Business

Through the use of proper irrigation system management, landscape irrigation can develop healthier plants and turf AND reduce the amount of pollutants leaving landscaped areas. The common problems associated with lacking irrigation system maintenance are:

- Leaking systems
- Over-spraying onto sidewalks, streets and parking lots
- Over-watering
- "Geysers" that discharge excessive amounts of water

It is important to address all of these common problems when performing inspections and system maintenance.

BMP Objective

The purpose of this best management practice is to prevent over-watering and over-spraying that leads to water leaving the landscape areas and entering the storm drain system carrying pollutants.

Implementation

See Irrigation Controller for more information on "smart" controllers that offer water saving features.

Develop regular inspection and maintenance schedules that include all functioning parts of the irrigation system. The purpose of the inspections and maintenance is to sustain an efficient and uniform distribution of the waters without over-watering, over-spraying or leaking.

Replace any damaged or inoperative parts of the system. Additionally, adjust ALL spray heads so that their spray patterns are trained only on the landscaped areas.

Limitations

Irrigation system maintenance considers many variables including parts and equipment, watering times and durations, and spray patterns. Each of these should be carefully inspected on a periodic basis as any one of them may lead to discharges of water from the landscaped areas to the sidewalks, streets and parking lots which carries pollutants to the storm drain system.

Landscaping Erosion Prevention

Erosion transports soil from properties and settles it downstream in the bottoms of rivers and streams. Besides the lost of valuable topsoil, erosion can significantly change habitats and make them unsuitable for existing fish and aquatic life. Landscaping should be designed to prevent erosion by securing soil with plant roots and covering exposed soil with some form of groundcover. Grading and terracing should also prevent runoff from entering storm drains. Finally, during the landscaping process, exposed soil should be protected from rain.

BMP Objective

The purpose of this best management practice is to reduce sediment runoff to storm drains.

Implementation

DO:

- Design landscaped areas so that terracing and landscaping does not direct runoff into the street or a storm drain. Terracing can slow the flow of water and consequently minimize erosion.
- Create zoned, water-efficient irrigation systems using technologies such as drip irrigation, soaker hoses, or microspray. This will minimize runoff from landscaped areas.
- Place permanent groundcover or mulch over exposed soil. Groundcover can be synthetic or organic, including compost, wood chips and river rocks. This will not only prevent erosion, it will reduce the need for watering and stop weeds from growing.
- Minimize the amount of watering that vegetated areas need, by carefully considering Plant Selection. Less watering creates less runoff.
- Schedule Activity in Dry Weather. Plan earth moving activities when rain will not interfere.
- Cover any exposed soil that may be vulnerable to rain. When not working, fasten a tarp over dirt piles, etc. Implement erosion and sediment controls as needed.
- Yard care service providers must arrange for proper disposal of green waste for the client through green waste disposal. Disposal records should be maintained by service provider.
- Sweep up any leaves, lawn clippings, or other debris and dispose of them as green waste, put them in your garden if they will not blow away or compost them. It is less expensive to dispose of green waste than landfill garbage, so don't contaminate green waste with garbage. In communities with curbside pickup of yard wastes, place clippings and pruning waste at the curb in approved bags or containers. For commercial disposal of green waste visit: http://www.co.san-diego.ca.us/dpw/recycling/pdf/GreenWasteRecyclingGuide.pdf

DON'T:

- Do not landscape riparian areas, except to remove non-native plants, and replace them with native riparian landscaping. See Plant Selection for more information.
- Do not remove native vegetation along creek banks or remove large woody debris from creek banks or creeks.

Plant Selection - General

Properly selecting and placing vegetation can significantly minimize the costs of maintaining gardens. Native landscapes are adapted to the local climate, insects, and soil, so they require less water, pesticides, and fertilizer. Consequently, these landscapes also require fewer chemicals and less time input from gardeners.

BMP Objective

The purpose of this best management practice is to reduce water and chemical use in vegetated areas.

Implementation

DO:

- Choose native plants. Do not assume something is native because you have seen it in your area. Contact your local nursery for information or visit the California Exotic Pest Plant Council website at www.caleppc.org.
- Contact California Native Plant Society for more information on native plant selection. www.CNPS.org
- Some plants attract "good bugs". These are referred to as "insectary plants" create a less hospitable habitat for pests. Some examples include:

    - Aster (Aster)
    - Baby blue eyes (Nemophila menziesii)
    - Calendula (Calendula)
    - California lilac (Ceanothus)
    - California poppy (Eschscholzia californica)
    - Chervil (Anthriscus cerefolium)
    - Chrysanthemum (Chrysanthemum)
    - Coriander (Coriander sativum)
    - Cosmos (Cosmos)
    - Coyote brush (Baccharis pilularis)
    - Dill (Anethum graveolens)
    - Elderberry (Sambucus mexicana)
    - Fleabane (Erigeron)
    - Holly-leaved cherry (Prunus ilicifolia)
    - Monkey flower (Mimulus)
    - Native buckwheat (Eriogonum)
    - Pincushion flower (Scabiosa)
    - Rosemary (Rosmarinus officinalis)
    - Rudbeckia (Rudbeckia)
    - Sunflower (Helianthus)
    - Tidy-tips (Layia platyglossa)
    - Toyon (Heteromeles arbutifolia)
    - Yarrow (Achillea)
    - Zinnia (Zinnia)

- Monitoring your plants will allow you to see if pests are at work in your yard.
- Some tolerance for damage may help to prevent use or need for chemical use.
- Mechanically pull weeds to reduce the need to spray herbicides.
- Place plants so that they will not outgrow their location. Pay attention to the anticipated height and width of the plant even if it may currently fit the location. Many native plants in an appropriate locations may not need pruning.
- Keep in mind that initial planting of native plants will require watering until the plants become established. Once established water may be cut back depending on the need of the plant.
- Also pay attention to how the roots of trees and shrubs may grow. Tree roots are a common cause of blockages in sewer lines and foundation problems. Problem trees include poplars, willows, figs, rubber trees, large eucalyptus trees, fruitless mulberry and the Modesto ash. For more information visit http://www.sewersmart.org/prevention-4.html

Properly Store, Use, and Dispose of Fertilizer

Fertilizer use is a significant source of pollution causing overgrowth of algae in waterways, which can kill fish and other aquatic life. If grass alone were considered a national crop, it would be the fifth largest in the nation. Accordingly, minimizing fertilizer use and runoff from lawns as well as gardens improves water quality. Fertilizers can also be toxic where they are applied, so proper handling can protect your immediate environment and employees.

BMP Objective

The purpose of this best management practice is to reduce fertilizer runoff to storm drains and waterways.

Implementation

DO:

- Consider Plant Selection (General or Nurseries) to reduce the need for fertilizers.
- Perform soil analysis seasonally to determine actual fertilization need and application rates.
- Fertilize garden areas with a mulch of leaves, bark, and composted manure and/or garden waste where it is not likely to get carried off into storm drains.
- Consider grass cycling when it is not likely to blow off and into storm drains. It can eliminate the need for fertilizers. Leave your clippings on the lawn when mowing. Once cut, grass clippings first dehydrate, then decompose, quickly disappearing from view. Proper mowing is required for successful grass cycling. Cut grass when the surface is dry, and keep the mower blades sharp. Follow the "1/3 Rule": mow the lawn often enough so that no more than 1/3 the length of the grass blade is cut in any one mowing. Frequent mowing will produce short clippings that will not cover up the grass surface. The lawn may have to be cut once every 7 days when the lawn is growing quickly but only every 7 to 14 days when it is growing slowly. However do not allow grass clippings to remain on adjacent hard surfaces where it cannot cycle.
- Apply chemical fertilizer only as needed, when plants can best use it, and when the potential for it being carried away by runoff is low. Make sure the fertilizer spreader is calibrated. Do not apply when there is a chance of rain.
- Leftover fertilizer must either be used up or stored properly.
- Store fertilizer is a water proof container or inside in a shed or storage cabinet where it is protected from rainfall.
- Store fertilizer off the ground.
- Do not remove labels from fertilizers.
- Dispose of unwanted fertilizer at a local collection point. Visit http://www.earth911.org/master.asp?s=ls&serviceid=183 to find a location near you.

DON'T:

- Never dispose of leftover fertilizers in the trash, gutter, street, or storm drain.

Properly Store, Use, and Dispose of Pesticides

Pesticides are potent chemicals. They make their way into waterways and the air, and are harmful to both wildlife and human health. A 1999 USGS Survey of urban streams found that insecticide concentrations frequently exceeded USEPA guidelines for protecting aquatic life. Pesticides used outdoors can also be brought inside on shoes and clothing, where they may contaminate carpets and floors. It is best to discourage pests using integrated pest management, but the effects of conventional pesticides can be minimized through proper handling.

BMP Objective

The purpose of this best management practice is to reduce pesticide use and runoff from gardens.

Implementation

DO:

- The label on a pesticide container is a legal document. Use pesticides as instructed only.
- Identify the specific problem or pest by taking a sample to your local nursery or contacting the Master Gardener's Program.
- Select a pesticide specifically for the pest to be exterminated.
- Spot treat wherever possible to minimize chemical use.
- Use mechanical methods of removing pests first. This may postpone the need for chemicals at all.
- Tolerate some damage.
- Look for less toxic methods for pest control.
- Employ Integrated Pest Management to avoid the use of or at least minimize the amount of hazardous chemicals used.
- Buy prepared pesticides instead of pesticides that need to be diluted. More concentrated pesticides pose greater environmental and health risks in storage and during handling. Spills are more likely to occur during mixing.
- If you do dilute pesticides, use rinse water from measuring cups, etc. as product. Do not wash this down any drain.
- Consider using baits and traps which instead of generally applying chemicals.
- Do not use aerosols. Aerosols carry pollutants into the air and are a risk to the person applying them as well as the environment (indoor or out). Air disperses the pollutants and carries them beyond the desired area for pest control.
- Avoid calendar application of pesticides. Instead, monitor the pest and treat for specific problems.
- Use gloves and masks when using pesticides if suggested by instructions. Gloves are not to avoid stains on hands, but to prevent chemicals from entering your blood stream through your skin.
- Store pesticides inside in a shed or storage cabinet where they are protected from rainfall.
- Do not remove labels from pesticide containers.
- Store pesticides off the ground.
- Contain and Clean Up Spills. Keep clean up materials for toxics such as pesticides nearby in a location known to all. Do not hose down spills but instead use paper towels or an absorbent such as kitty litter. Sweep up absorbent or gather the towels, put them in a sealed container and dispose of them as hazardous waste.
- When you are ready to dispose of pesticides, first rinse empty containers and use rinse water as product. Small cleaned containers may be disposed of in the garbage.
- Dispose of unwanted pesticides at a local collection point. Visit http://www.earth911.org/master.asp?s=ls&serviceid=179 to find a location near you.

DON'T:

- Do not apply pesticides outside when there is a chance of rain. This creates a high potential for pesticides to wash into storm drains. Avoid irrigation in the areas where pesticides are applied, at least until they have had a chance to work.
- Do not dispose of any pesticide by pouring it into the street, a storm drain, drains in your home, or the toilet.
- Do not put pesticides in the trash.

Use Non-Toxic Products

While many people are aware of outdoor air quality issues, many do not consider how the chemicals used inside buildings may degrade indoor air quality. Chemicals used outdoors can also be tracked in on shoes, etc. If you use non-toxic materials on your property, you minimize risks to the environment and your employees. In many cases, non-toxic products are just as effective as more toxic traditional products and readily available through alternative suppliers.

BMP Objective

This purpose of this best management practice is to reduce pollutants that are commonly found in stormwater.

Implementation

DO:

- Look for labels that state product is "non-toxic," "non-petroleum based," "free of ammonia, phosphates, dye, or perfume," or "readily biodegradable."
- Read label ingredients. Avoid phenols, formaldehyde, and caustic or acid products.
- Consider replacing the following products:
    - Automotive Products: Alternatives to grease lubricants, car polishes, degreasers, and windshield washer solution are all available as well as refined motor oil.
    - Vehicle/Trailer lubrication: Adhesive lubricants can replace typical chassis grease.
    - Cleaners: Look for vegetable-based or citrus-based soaps as opposed to petroleum-based soaps and detergents.
    - Paint products: Water-based paints, wood preservatives, stains and finishes are available.
    - Pesticides: Alternative products and methods can control most insects, fungi and weeds. See Implement IPM for more information.
    - Chemical Fertilizers: Compost and soil amendments are natural alternatives.
    - Consumables: Manufacturers have reduced or are in the process of reducing heavy metals in consumables such as batteries and fluorescent lamps. Low mercury containing fluorescent lamps are now available in most hardware and lighting stores. Rechargeable batteries minimize heavy metal waste.
    - Janitorial chemicals: Even biodegradable soap can harm fish and wildlife before it biodegrades. Safer products and procedures are available for floor stripping and cleaning, as well as carpet, glass, metal and restroom cleaning and disinfecting.
    - Aerosols: Use pump-type or non-aerosol products
    - chlorinated solvents; CFCs, and 1,1,1 trichloroethane (TCA): Alternatives to all of these products exist.
- Promote your business by obtaining recognition from the County of San Diego as a Green Business. See http://www.sdcounty.ca.gov/deh/hmd/greenbusiness.html for more information.

DON'T:

- Do not assume non toxic or biodegradable products are safe. Non-toxic means the product is not toxic to the user. Biodegradable means the product will eventually break down, but it may harm the environment in the meantime.
- Do not dispose of any toxic chemical by pouring it into the street, a storm drain, drains in your home, or the toilet. Take responsibility for Proper Disposal of HHW. Other Businesses may have to contract with professional services to dispose of hazardous waste.

Limitations

Availability and cost of alternative products may be a limiting factor.

Weed Control

Chemical weed control is often favored over mechanical weed control, but chemicals can harm both the environment and the person applying them. Humans can absorb herbicides through skin contact, or inhale them. Herbicides on outside vegetation can also be tracked indoors on shoes and deposited on carpets or floors. If herbicides are washed into stormwater, they can impair the health of aquatic life.

BMP Objective

The purpose of this best management practice is to reduce herbicide runoff to the storm drain system.

Implementation

DO:

- Prevent weeds by planting groundcover. Ivy, for example, will deter weeds. Ground covers are often invasive, however, so confine them to isolated areas.
- To control weeds, use drip irrigation and mulch. Wheat straw and hardwood leaves, are examples of good mulches.
- If possible, hand-pull weeds including roots.
- Otherwise, cut weeds down to the ground. Repeat cutting before they flower, grow new leaves, or go to seed.
- Use herbicides containing pelargonic acid or herbicidal soap as a last resort.
- In order to dispose of herbicide containers, first rinse them and use the rinse water as product. Clean containers can be put in the garbage.
- Follow all instructions on container when using herbicides.
- In San Diego County application of pesticides are regulated through the Department of Agriculture, Weights and Measures, Standards Compliance Program. Contact the Department for specific requirements and conditions tha may impact your facility compliance.

DON'T:

- Do not over apply herbicide, or fail to properly dilute herbicides. Follow the instructions on the container.
- Do not dispose of unwanted herbicide in any drain, the street, or in the garbage. It should be disposed of as hazardous waste. See http://www.earth911.org/master.asp?s=ls&cat=9&serviceid=181&type=-1 for disposal location in your area.

Limitations

Mechanical weed control may not be feasible for some users given limit time resources.

Street and Parking Lot Sweeping

Business parks, retail centers, and multi-residential properties generally have parking lots and internal streets associated with the properties. Pollutants build-up on the street surface and can be washed or blown into the storm drain system. Once in the storm drain system, the pollutants travel to the creeks, lagoons and the ocean. Sweeping of the streets and parking lots will eliminate these pollutants from the surface, not allowing them to enter the storm drain system.

BMP Objective

The purpose of this best management practice is to sweep up materials from streets and parking lots so they do not enter the storm drain system when it rains or when the wind blows.

Implementation

Both hand sweeping and mechanical sweeping are options for cleaning parking lots and internal streets. Selection of the type of sweeping depends on the size of the parking lot and internal streets. Specialized sweeping or other cleaning, for example, power washing, may be required based on the types of pollutants that are found on the surfaces.

Hand sweeping should be limited to very small parking lot areas, where it may be cost effective. Sweeping should include the use of a broom and pan to collect the wastes. The wastes should then be disposed of properly in a waste receptacle.

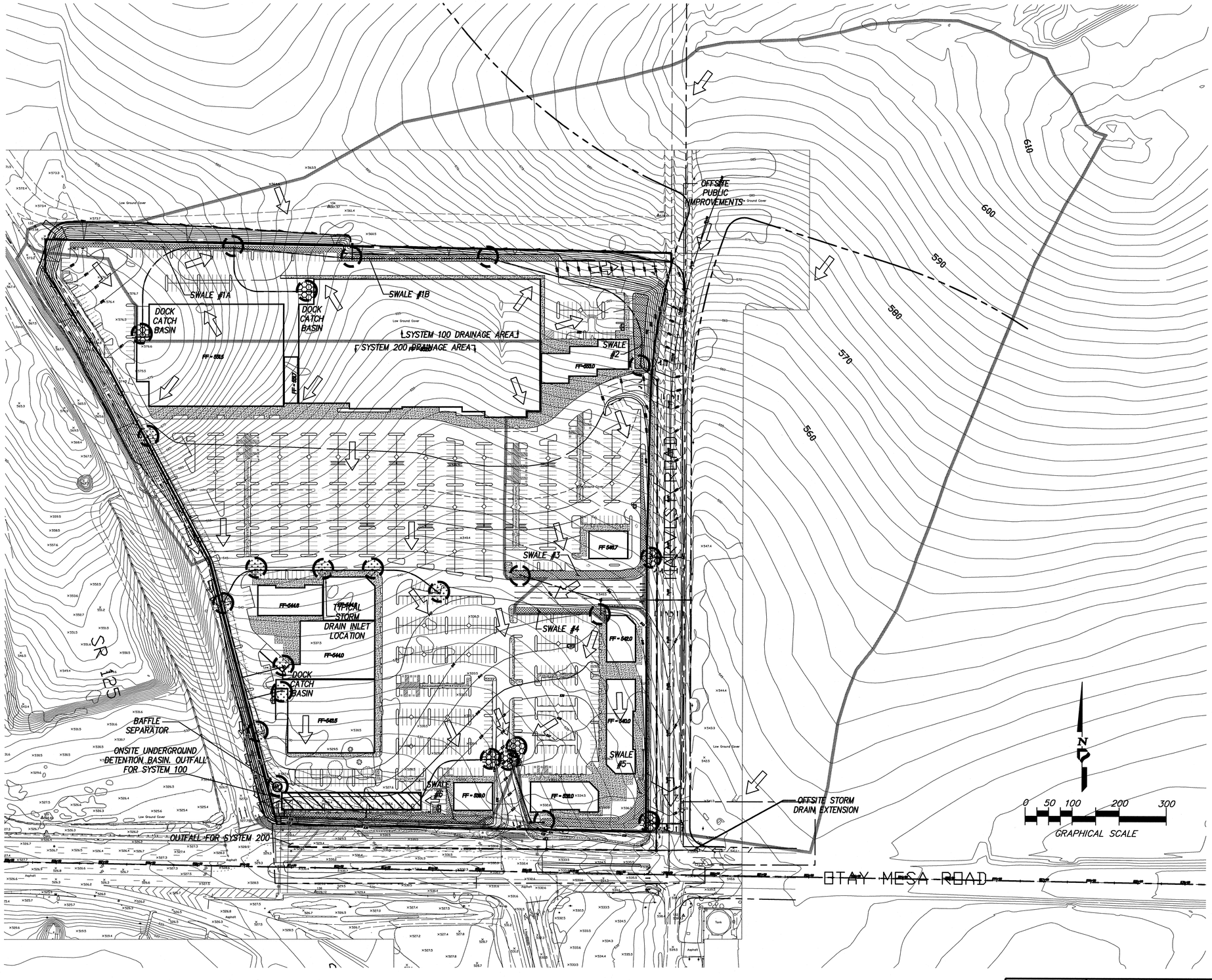
Larger surfaces should employ the use of a mechanical street sweeper. There are many vendors (see San Diego street sweep) who perform sweeping services locally. It is important to request information about the types of street sweepers used and their effectiveness at cleaning the types of pollutants observed in your individual properties. Oil and grease is much different than trash and landscaping debris and may need alternative sweeping methods employed to be effective.

Limitations

It is important to recognize that although street sweeping is effective at cleaning most solids from surfaces, oil and grease as well as other liquid and solid wastes may not be picked up by the sweepers. Other surface cleaning methods, including power washing, may be required to effectively clean the surfaces of pollutants.

ATTACHMENT C

LID and/or TC-BMP Exhibit



POST-CONSTRUCTION BMP NOTES:

1) TO THE MAXIMUM EXTENT PRACTICABLE, DRAINAGE FROM ROOFTOPS AND IMPERVIOUS AREAS WILL BE DISCHARGED INTO LANDSCAPING PRIOR TO REACHING THE STORM DRAIN SYSTEM.

2) TO THE MAXIMUM EXTENT PRACTICABLE, RUNOFF FROM THE SITE WILL BE DIRECTED INTO VEGETATED SWALES PRIOR TO ENTERING THE ONSITE UNDERGROUND DETENTION BASIN.

3) PARKING LOT AISLES WILL BE CONSTRUCTED TO THE MINIMUM WIDTHS NECESSARY, WITHOUT COMPROMISING PUBLIC SAFETY.

4) ALL SLOPES WILL BE PROTECTED IN PLACE OR STABILIZED WITH HYDROSEED OR EQUIVALENT EROSION CONTROL MEASURES. NATIVE OR DROUGHT-TOLERANT VEGETATION WILL BE USED FOR SOIL STABILIZATION.

5) RUNOFF WILL BE CONVEYED SAFELY AWAY FROM THE TOPS OF SLOPES.

6) ALL ONSITE INLETS AND CATCH BASINS WILL BE STENCILED WITH PROHIBITIVE LANGUAGE SUCH AS "NO DUMPING – I LIVE DOWNSTREAM" AND GRAPHICAL ICONS TO DISCOURAGE ILLEGAL DUMPING, AS APPROVED BY THE COUNTY ENGINEER.

7) ALL TRASH STORAGE AREAS WILL BE PAVED WITH AN IMPERVIOUS SURFACE, DESIGNED NOT TO ALLOW RUN-ON FROM ADJOINING AREAS, AND SCREENED OR WALLED TO PREVENT OFF-SITE TRANSPORT OF TRASH. TRASH RECEPTACLES WILL BE LOCATED IN COVERED AREAS OR AFFIXED WITH LIDS TO PREVENT DIRECT PRECIPITATION. ALL SPILLS WILL BE ADDRESSED IN A TIMELY MANNER AND THE AREA WILL BE CLEANED ON A REGULAR BASIS TO REDUCE THE POSSIBILITY OF VECTOR PROBLEMS AND BACTERIAL GROWTH.

8) TO THE MAXIMUM EXTENT PRACTICABLE, NATIVE OR DROUGHT-TOLERANT TREES, SHRUBS, AND GROUND COVER WILL BE PLANTED INSTEAD OF NON-DROUGHT TOLERANT EXOTICS FOR WATER CONSERVATION AND CANOPY INTERCEPTION.

9) TIMINGS AND APPLICATION METHODS OF IRRIGATION WILL BE DESIGNED TO MINIMIZE RUNOFF OF EXCESS IRRIGATION WATER INTO THE STORM WATER CONVEYANCE SYSTEM. IRRIGATION WILL BE DESIGNED FOR AREA SPECIFIC WATER REQUIREMENTS.

10) ALL LANDSCAPED AREAS WILL INCLUDE RAIN SHUTOFF DEVICES TO PREVENT IRRIGATION DURING AND AFTER PRECIPITATION. FLOW REDUCERS AND SHUTOFF VALVES TRIGGERED BY PRESSURE DROPS SHALL BE USED TO CONTROL WATER LOSS FROM BROKEN SPRINKLER HEADS OR LINES.

11) THE NEED FOR PESTICIDE WILL BE REDUCED TO THE MAXIMUM EXTENT PRACTICABLE BY USING PEST-RESISTENT OR WELL-ADAPTED NATIVE PLANT VARIETIES AND BY DISTRIBUTING INTEGRATED PEST MANAGEMENT (IPM) EDUCATIONAL MATERIALS TO THE BUSINESSES AND GROUNDSKEEPERS.

12) ONLY PEST MANAGEMENT PROFESSIONALS WILL BE USED FOR THE APPLICATION OF PESTICIDES. MATERIALS ON HOW TO CONTROL PESTS USING NON-TOXIC METHODS WILL BE MADE AVAILABLE.

13) CATCH BASINS WITHIN THE LOADING/UNLOADING DOCK AREAS WILL BE EQUIPPED WITH SHUT-OFF VALVES AND CONTAINMENT AREAS.

14) RESTAURANTS/FOOD SERVICES WILL BE EQUIPPED WITH A CLARIFIER, GREASE TRAP, OR OTHER PRETREATMENT DEVICE, AS REQUIRED MY THE COUNTY, PRIOR TO DISCHARGING TO THE SANITARY SEWER.

15) EQUIPMENT AND MATS WILL BE CLEANED WITHIN THE BUILDINGS.

16) BY REGULARLY SWEEPING AND VACUUMING THE PARKING AREAS AND THE SURROUNDING HARDSCAPE, THE AMOUNT OF POLLUTANTS ENTERING THE STORM DRAINS AND RECEIVING WATERS WILL BE GREATLY REDUCED.

17) EDUCATIONAL MATERIALS ON STORM WATER ISSUES AND SIMPLE WAYS TO PREVENT STORM WATER POLLUTION WILL BE MADE AVAILABLE TO THE BUSINESSES AND THEIR EMPLOYEES.

18) THE FOLLOWING TREATMENT BMPs WILL BE USED TO TREAT PROJECT RUNOFF PRIOR TO OFFSITE DISCHARGE: STORM DRAIN INLETS WITH INLET INSERTS, A BAFFLE SEPARATOR, AND GRASS SWALES. THE MAJORITY OF THE ONSITE FLOW WILL ENTER THE ONSITE UNDERGROUND DETENTION BASIN, WHICH WILL MITIGATE THE INCREASE IN PEAK FLOW DUE TO DEVELOPMENT. IF THE HDS UNIT IS NOT USED, DOWNSPOUTS THAT DIRECTLY CONNECT WITH THE STORM DRAIN SYSTEM WILL BE EQUIPPED WITH DOWNSPOUT FILTERS AND ADDITIONAL PARKING LOT CATCH BASINS WILL BE EQUIPPED WITH INLET INSERTS.

19) MAINTENANCE OF THE POST-CONSTRUCTION BMPs WILL BE THE RESPONSIBILITY OF THE CALIFORNIA CROSSINGS' BUSINESS OWNERS ASSOCIATION AFTER THE INITIAL INSTALLATION.

20) ALL DRAINAGE AND WATER QUALITY FEATURES WITHIN THIS DEVELOPMENT AND OUTSIDE THE PUBLIC RIGHT-OF-WAY WILL BE PRIVATE AND PRIVATELY MAINTAINED.

LEGEND

- DRAINAGE SUBAREA
- FLOW DIRECTION
- BIORETENTION AREA/SWALE
- UNDERGROUND DETENTION (~1.2 ACFT)
- STORM DRAIN INLET LOCATIONS
- BAFFLE SEPARATOR

STORM DRAIN INLET LOCATIONS TO BE EQUIPPED W/FILTRATION DEVICES

STORM DRAIN INLET LOCATIONS W/POTENTIAL FILTRATION DEVICES (IF THE HDS UNIT IS NOT USED)

SCALE:	1"=100'
JOB #:	3315.00
CREATED:	3/21/07

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Environmental | Engineering | Survey
701 B Street, Suite 800 San Diego, CA 92101
619.235.6471 Tel 619.234.0349 Fax

COUNTY OF SAN DIEGO
CALIFORNIA CROSSINGS

LID + TREATMENT BMP LOCATION MAP
ATTACHMENT C

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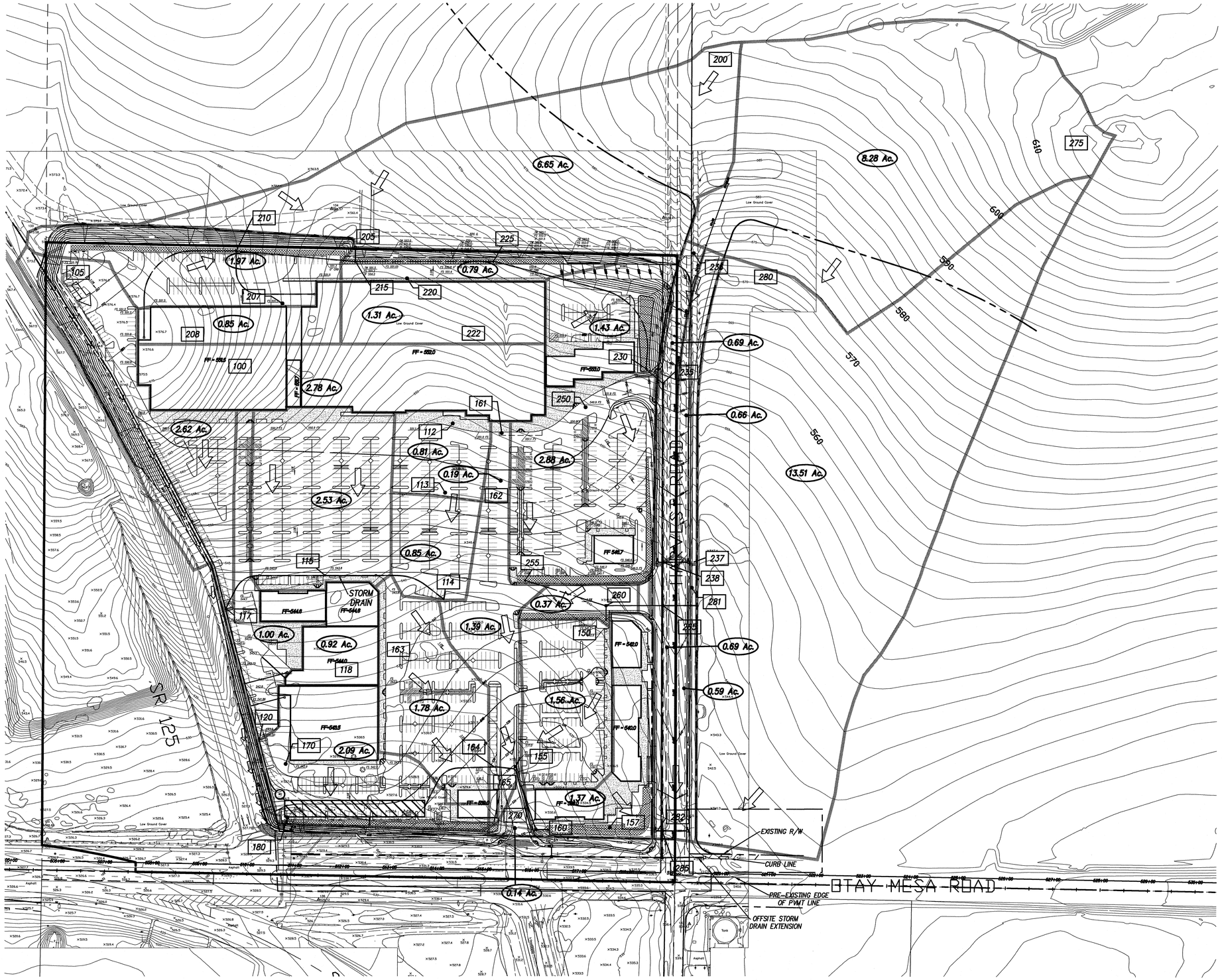
ATTACHMENT D

Drainage Management Area (DMA) Maps, Sizing Design Calculations and TC-BMP/LID Design Details



LEGEND

- DRAINAGE SUBAREA
- AREA FROM UPSTREAM TO DOWNSTREAM NODE — X.XX Ac.
- FLOW DIRECTION
- HYDROLOGY NODE — #
- BIOSWALE
- UNDERGROUND DETENTION (~1.2 ACFT)

N

0 50 100 200 300

GRAPHICAL SCALE

SCALE:	1"=100'
JOB #:	3315.00
CREATED:	3/21/07

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Environmental | Engineering | Survey
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COUNTY OF SAN DIEGO
CALIFORNIA CROSSINGS

HYDROLOGY MAP
DEVELOPED CONDITIONS
EXHIBIT A

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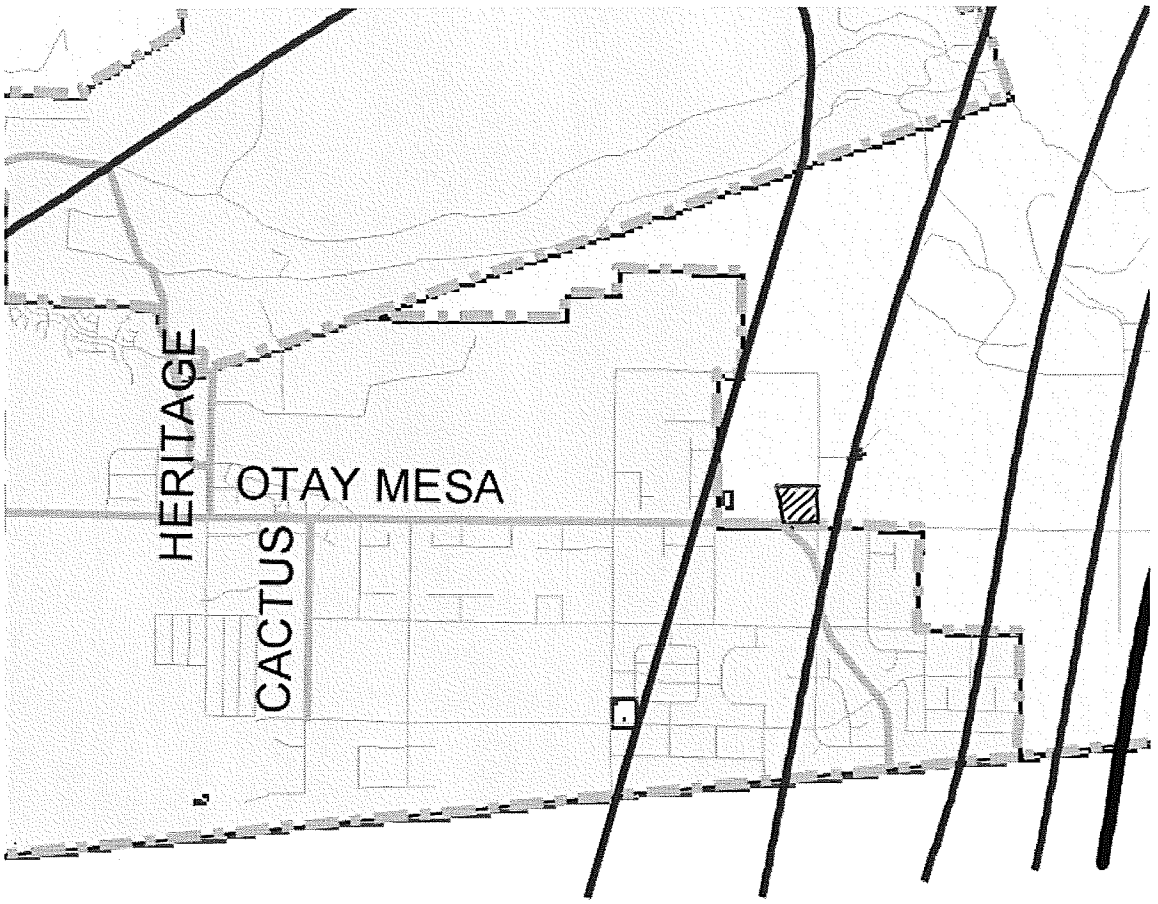


0.75

0.55

San Diego County 85th Percentile Isopluvials, Draft 8/7/2003

A partially pervious area may be drained to a self-retaining area. For example, a driveway composed of unit pavers may drain to an adjacent lawn. In this case, the maximum ratios are:

(Runoff factor) x (tributary area) $\leq$ 2 x (self-retaining area) *Equation 4-1*

Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Under some circumstances, pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) can be self-retaining. Adjacent roofs or impervious pavement may drain on to the pervious pavement in the same maximum ratios as described above.

To design a pervious pavement to be a self-treating area, ensure:

- The gravel base course is a minimum of four or more inches deep.
- The base course is not to be underdrained.
- A qualified engineer has been consulted regarding infiltration rates, pavement stability, and suitability for the intended traffic.

Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors for surfaces draining to IMPs.

Surface	Factor
Roofs	1.0
Concrete	1.0
Pervious Concrete	0.1
Porous Asphalt	0.1
Grouted Unit Pavers	1.0
Solid Unit Pavers on granular base, min. 3/16 inch joint space	0.2
Crushed Aggregate	0.1
Turfblock	0.1
Amended, mulched soil	0.1
Landscape	0.1

Areas draining to IMPs are multiplied by a sizing factor to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

TABLE 4-3. Format for Tabulating Self-Treating Areas

DMA Name	*Area (square feet)*

TABLE 4-4. Format for Tabulating Self-Retaining Areas

DMA Name	*Area (square feet)*

TABLE 4-5. FORMAT FOR TABULATING Areas Draining to Self-Retaining Areas

DMA Name	*Area (square feet)*	*Post-project surface type*	*Runoff factor*	*Receiving self-retaining DMA*	*Receiving self-retaining DMA Area (square feet)*

► STEP 4: SELECT AND LAY OUT IMPS ON SITE PLAN

Select from the list of IMPs in Table 4-6. Illustrations, designs, and design criteria for the IMPs are in the "IMP Design Details and Criteria" at the end of this chapter.

Once you have laid out the IMPs, calculate the square footage you have set aside on your site plan for each IMP.

► STEP 5: REVIEW SIZING FOR EACH IMP

For each of the IMPs, use the appropriate sizing from Table 4-6.

TABLE 4-6. IMP Sizing

Bioretention Facilities	Sizing Factor for Area = 0.04
Flow-through Planters	Sizing Factor for Area = 0.04
Dry Well or Infiltration Basin	See Step 6 to Calculate Min. Volume
Cistern with Bioretention	See Step 6 to Calculate Min. Volume of Cistern; then use 0.04 to calculate minimum size of bioretention area

▶ STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

The minimum area of bioretention facilities and flow-through planters is found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

$$Min.\ IMP\ Area = \sum \begin{pmatrix} DMA \\ Square \\ Footage \end{pmatrix} \times \begin{pmatrix} DMA \\ Runoff \\ Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix}$$

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes for **bioretention areas** and **planter boxes**:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas for bioretention areas and planter boxes.

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*	*Soil Type:*	*IMP Name*			
					IMP Sizing factor		*Minimum Area*	*Proposed Area*	
			Total		***0.04***				***IMP Area***

See attached table

To size **dry wells**, **infiltration basins**, or **infiltration trenches**, use the following procedure:

1. Use the County of San Diego's 85th Percentile Isopluvial Map to determine the minimum unit volume.
2. Determine the weighted runoff factor ("C" factor) for the area tributary to the facility. The factors in Table 4-2 may be used.
3. Multiply the weighted runoff factor times the tributary area times the minimum unit volume.

Equation 4-8

$$Volume = [Tributary\ Area] \times [weighted\ runoff\ factor] \times [unit\ volume]$$

4. Select a facility depth.

5. Determine the required facility area. Dry wells may be designed as an open vault or with rock fill. If rock fill is used, assume a porosity of 40%.

6. Ensure the facility can infiltrate the entire volume within 72 hours.

To size a **cistern in series with a bioretention facility**:

1. Use Equation 4-8 to calculate the required cistern volume.

2. Design a discharge orifice for a drawdown time of 24 hours.

3. Determine the maximum discharge from the orifice.

4. The minimum area of the bioretention facility must treat this flow based on a percolation rate of 5" per hour through the engineered soil.

► STEP 7: DETERMINE IF AVAILABLE SPACE FOR IMP IS ADEQUATE

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1 – 6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the SUSMP sizing requirements. If not, revise the plan accordingly. Revisions may include:

- Reducing the overall imperviousness of the project site.
- Changing the grading and drainage to redirect some runoff toward other IMPs which may have excess capacity.
- Making tributary landscaped DMAs self-treating or self-retaining.
- Expanding IMP surface area.

► STEP 8: COMPLETE YOUR SUMMARY REPORT

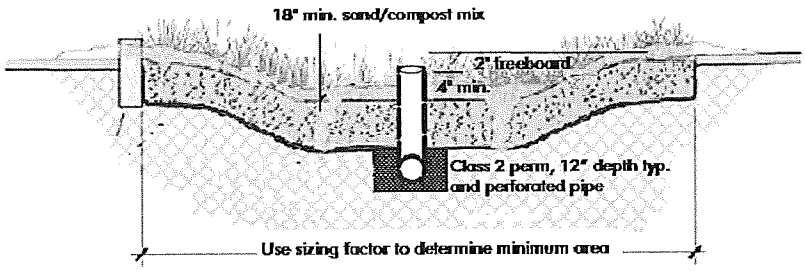
Present your IMP sizing calculations in tabular form. Adapt the following format as appropriate to your project. Coordinate your presentation of DMAs and calculation of minimum IMP sizes with the Project Submittal drawing (labeled to show delineation of DMAs and locations of IMPs). It is also helpful to incorporate a brief description of each DMA and each IMP.

Sum the total area of all DMAs and IMPs listed and show it is equal to the total project area. This step may include adjusting the square footage of some DMAs to account for area used for IMPs.

Ch 4 SUSMP - Sizing for each IMP

Bioretention Area	TRIBUT Area (ac)	4% RULE MIN REQD	Provided Area (ac)	Adequately sized?
1A	2.82	0.11	0.12	OK
1B	2.1	0.08	0.11	OK
2	1.42	0.06	0.08	OK
3	2.88	0.12	0.15	OK
4	0.37	0.01	0.05	OK
5	1.37	0.05	0.14	OK
6	2.09	0.08	0.15	OK

Bioretention Facilities



Bioretention facility configured for treatment-only requirements. Bioretention facilities can rectangular, linear, or nearly any shape.

Bioretention detains runoff in a surface reservoir, filters it through plant roots and a biologically active soil mix, and then infiltrates it into the ground. Where native soils are less permeable, an underdrain conveys treated runoff to storm drain or surface drainage.

Bioretention facilities can be configured in nearly any shape. When configured as linear **swales**, they can convey high flows while percolating and treating lower flows.

Bioretention facilities can be configured as in-ground or above-ground planter boxes, with the bottom open to allow infiltration to native soils underneath. If infiltration cannot be allowed, use the sizing factors and criteria for the Flow-Through Planter.

► CRITERIA

For development projects subject only to runoff treatment requirements, the following criteria apply:

Parameter	Criterion
Soil mix depth	18 inches minimum
Soil mix minimum percolation rate	5 inches per hour minimum sustained (10 inches per hour initial rate recommended)
Soil mix surface area	0.04 times tributary impervious area (or equivalent)

Best Uses

- Commercial areas
- Residential subdivisions
- Industrial developments
- Roadways
- Parking lots
- Fit in setbacks, medians, and other landscaped areas

Advantages

- Can be any shape
- Low maintenance
- Can be landscaped

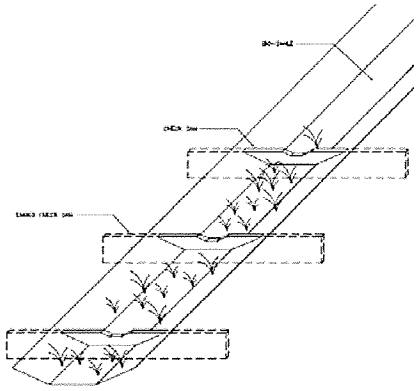
Limitations

- Require 4% of tributary impervious square footage
- Typically requires 3-4 feet of head
- Irrigation typically required

Parameter	Criterion
Surface reservoir depth	6 inches minimum; may be sloped to 4 inches where adjoining walkways.
Underdrain	Required in Group "C" and "D" soils. Perforated pipe embedded in gravel ("Class 2 permeable" recommended), connected to storm drain or other accepted discharge point.

► DETAILS

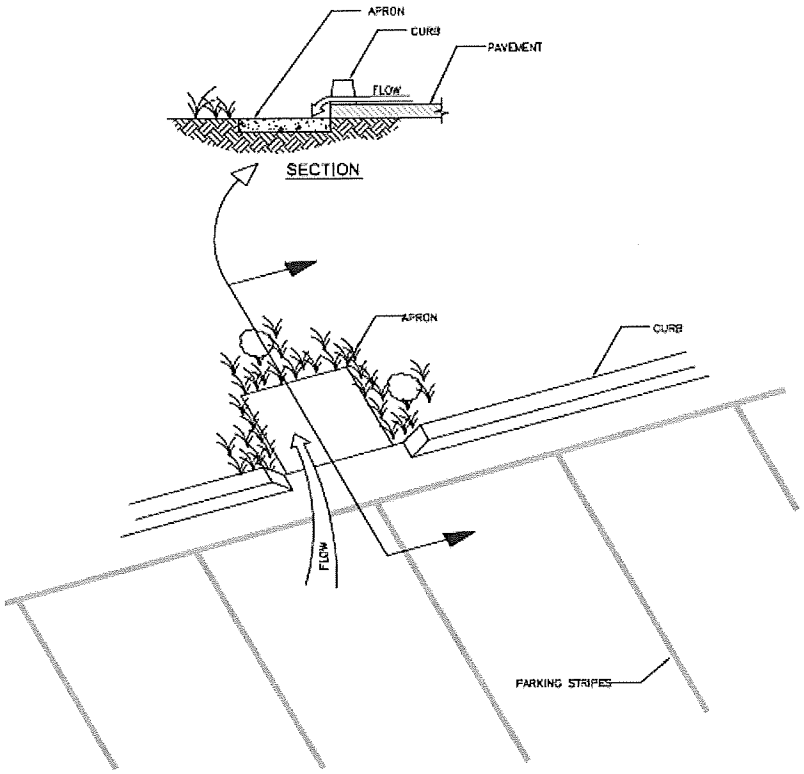
Plan. On the surface, a bioretention facility should be one level, shallow basin—or a series of basins. As runoff enters each basin, it should flood and fill throughout before runoff overflows to the outlet or to the next downstream basin. This will help prevent movement of surface mulch and soil mix.



Use check dams for linear bioretention facilities (swales) on a slope.

In a linear swale, check dams should be placed so that the lip of each dam is at least as high as the toe of the next upstream dam. A similar principle applies to bioretention facilities built as terraced roadway shoulders.

Inlets. Paved areas draining to the facility should be graded, and inlets should be placed, so that runoff remains as sheet flow or as dispersed as possible. Curb cuts should be wide (12" is recommended) to avoid clogging with leaves or debris. Allow for a minimum reveal of 4"-6" between the inlet and soil mix elevations to ensure turf or mulch buildup does not block the inlet. In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet.



Recommended design details for bioretention facility inlets (see text).

Where runof[illegible] landscaping from high-velocity flows with energy-dissipating rocks. In larger installations, provide cobble-lined channels to better distribute flows throughout the facility.

Upturned pipe outlets can be used to dissipate energy when runoff is piped from roofs and upgradient paved areas.

Soil mix. The required soil mix is similar to a loamy sand. It must maintain a minimum percolation rate of 5" per hour throughout the life of the facility, and it must be suitable for maintaining plant life. Typically, on-site soils will not be suitable due to clay content.

Storage and drainage layer. "Class 2 permeable," Caltrans specification 68-1.025, is recommended. Open-graded crushed rock, washed, may be used, but requires 4"-6" washed pea gravel be substituted at the top of the crushed rock gravel layers. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer or the gravel drainage layer from the native soil.

Underdrains. No underdrain is required where native soils beneath the facility are Hydrologic Soil Group A or B. For treatment-only facilities where native soils are Group C or D, a perforated

pipe must be bedded in the gravel layer and must terminate at a storm drain or other approved discharge point.

Outlets. In treatment-only facilities, outlets must be set high enough to ensure the surface reservoir fills and the entire surface area of soil mix is flooded before the outlet elevation is reached. In swales, this can be achieved with appropriately placed check dams.

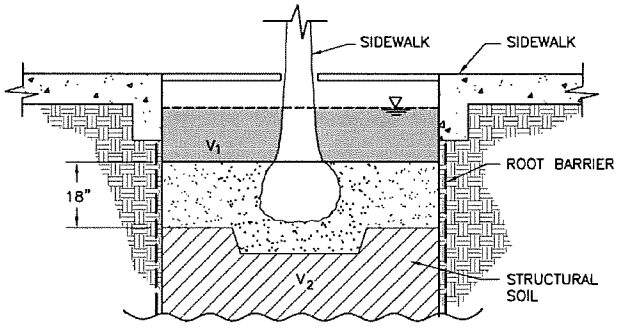
The outlet should be designed to exclude floating mulch and debris.

Vaults, utility boxes and light standards. It is best to locate utilities outside the bioretention facility—in adjacent walkways or in a separate area set aside for this purpose. If utility structures are to be placed within the facility, the locations should be anticipated and adjustments made to ensure the minimum bioretention surface area and volumes are achieved. Leaving the final locations to each individual utility can produce a haphazard, unaesthetic appearance and make the bioretention facility more difficult to maintain.

Emergency overflow. The site grading plan should anticipate extreme events and potential clogging of the overflow and route emergency overflows safely.

Trees. Bioretention areas can accommodate small or large trees. There is no need to subtract the area taken up by roots from the effective area of the facility. Extensive tree roots maintain soil permeability and help retain runoff. Normal maintenance of a bioretention facility should not affect tree lifespan.

The bioretention facility can be integrated with a tree pit of the required depth and filled with structural soil. If a root barrier is used, it can be located to allow tree roots to spread throughout the bioretention facility while protecting adjacent pavement. Locations and planting elevations should be selected to avoid blocking the facility's inlets and outlets.



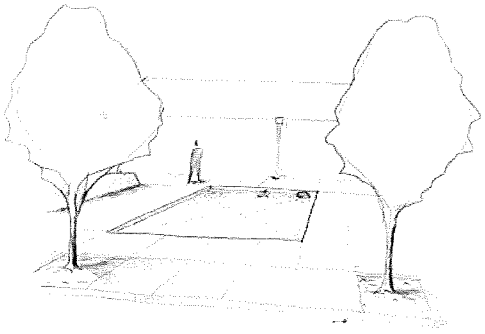
Bioretention facility configured as a tree well.
The root barrier is optional.

▶ APPLICATIONS

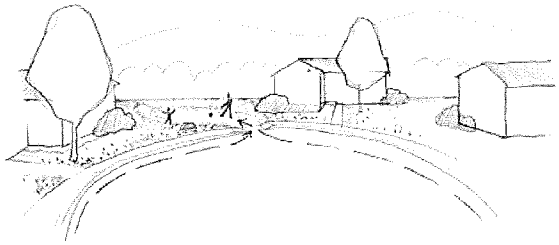
Multi-purpose landscaped areas. Bioretention facilities are easily adapted to serve multiple purposes. The loamy sand soil mix will support turf or a plant palette suitable to the location and a well-drained soil.

Example landscape treatments:

- Lawn with sloped transition to adjacent landscaping.
- Swale in setback area
- Swale in parking median
- Lawn with hardscaped edge treatment
- Decorative garden with formal or informal plantings
- Traffic island with low-maintenance landscaping
- Raised planter with seating
- Bioretention on a terraced slope



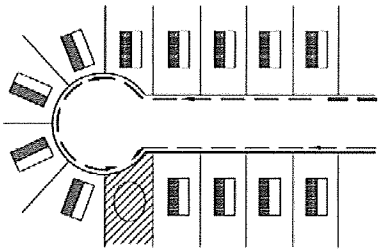
Bioretention facility configured as a recessed decorative lawn with hardscaped edge.



Bioretention facility configured and planted as a lawn/ play area.

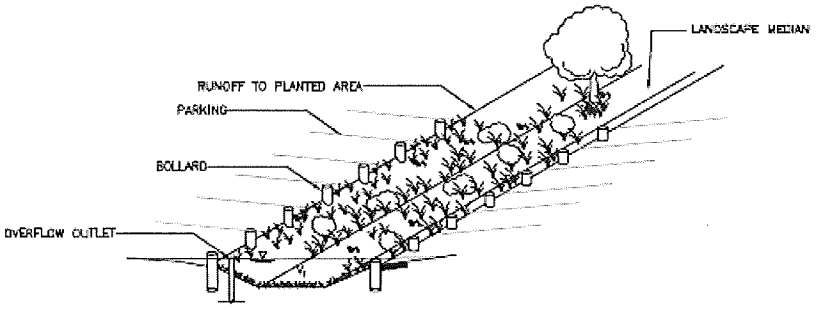
Residential subdivisions. Some subdivisions are designed to drain roofs and driveways to the streets (in the conventional manner) and then drain the streets to bioretention areas, with one bioretention area for each 1 to 6 lots, depending on subdivision layout and topography.

If allowed by the local jurisdiction, bioretention areas can be placed on a separate, dedicated parcel with joint ownership.



Bioretention facility receiving drainage from individual lots and the street in a residential subdivision.

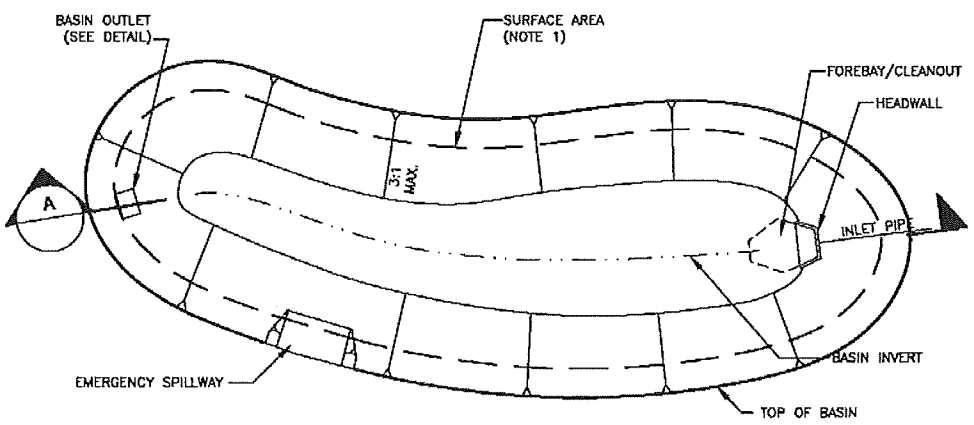
Sloped sites. Bioretention facilities must be constructed as a basin, or series of basins, with the circumference of each basin set level. It may be necessary to add curbs or low retaining walls.



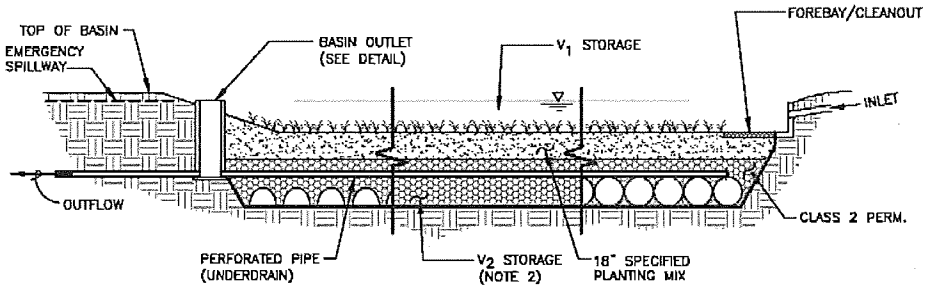
Bioretention facility configured as a parking median.
Note use of bollards in place of curbs, eliminating the need for curb cuts.

Design Checklist for Bioretention

- ❒ Volume or depth of surface reservoir meets or exceeds minimum.
- ❒ 18" depth "loamy sand" soil mix with minimum long-term percolation rate of 5"/hour.
- ❒ Area of soil mix meets or exceeds minimum.
- ❒ Perforated pipe underdrain bedded in "Class 2 perm" with connection and sufficient head to storm drain or discharge point (except in "A" or "B" soils).
- ❒ No filter fabric.
- ❒ Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 6 inches and a watertight cap.
- ❒ Location and footprint of facility are shown on site plan and landscaping plan.
- ❒ Bioretention area is designed as a basin (level edges) or a series of basins, and grading plan is consistent with these elevations. If facility is designed as a swale, check dams are set so the lip of each dam is at least as high as the toe of the next upstream dam.
- ❒ Inlets are 12" wide, have 4"-6" reveal and an apron or other provision to prevent blockage when vegetation grows in, and energy dissipation as needed.
- ❒ Overflow connected to a downstream storm drain or approved discharge point.
- ❒ Emergency spillage will be safely conveyed overland.
- ❒ Plantings are suitable to the climate and a well-drained soil.
- ❒ Irrigation system with connection to water supply.
- ❒ Vaults, utility boxes, and light standards are located outside the minimum soil mix surface area.
- ❒ When excavating, avoid smearing of the soils on bottom and side slopes. Minimize compaction of native soils and "rip" soils if clayey and/or compacted. Protect the area from construction site runoff.



PLAN VIEW
NOT TO SCALE

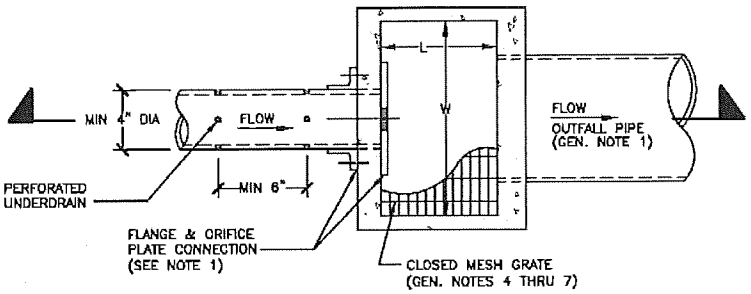


A SECTION
NOT TO SCALE

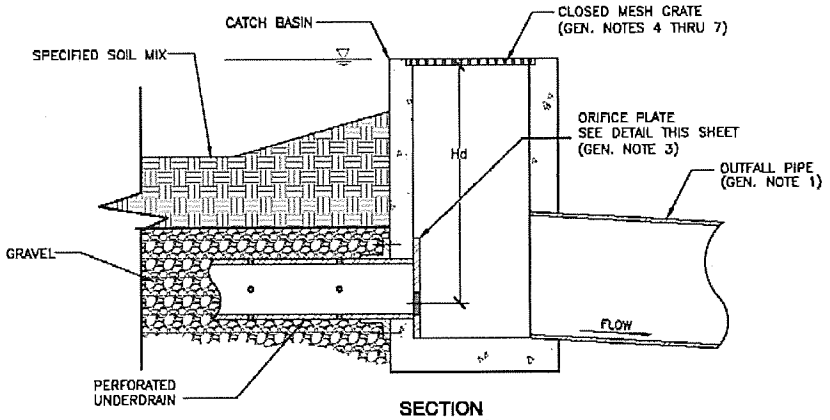
NOTE

1. SURFACE AREA LIMIT DETERMINED BY EXTENT OF SPECIFIED PLANTING MIX, WHICH IS GOVERNED BY THE OUTLET SPILL ELEVATION. FOR REQUIRED SURFACE AREA REFER TO THE FACTORS AND EQUATIONS IN THE STORMWATER C.3 GUIDEBOOK.
2. V_2 STORAGE ACCOMPLISHED WITH INFILTRATION ARCHES, PERFORATED PIPES, CLASS 2 PERM OR OTHER AT THE DESIGNERS DISCRETION.

Bioretention Facility



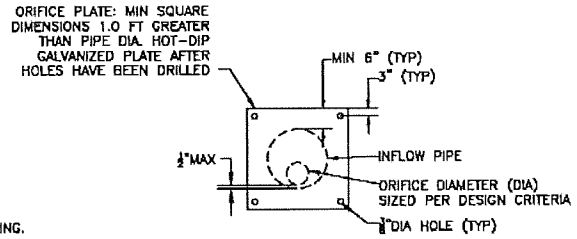
PLAN
N.T.S.



SECTION
N.T.S.

NOTE

1. ORIFICE PLATE & FLANGE CONNECTION TO CONCRETE SHALL BE FITTED WITH 30 DUROMETER NEOPRENE RING.



FLOW CONTROL ORIFICE PLATE

Bioretention Facility Outlet Detail - A

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Swales: Design Details

Comprehensive guidelines for the design of swales can be found in Chapter 8 "Swales and buffer strips" in the WSUD Engineering Procedures available for purchase from CSIRO publishing. A number of 'rules of thumb', along with design techniques for sizing swales, are presented below:

- The area of a swale should be around 1% the area that drains to the swale.
- Swales should not be used in areas where maximum flow rates exceed 0.3 m/s (Horner et al 1994) for a 1-year ARI (average recurrence interval) event, or 1.0 m/s for a 100-year ARI event.
- The depth of stormwater should not exceed the height of the grass even in 100-year ARI events, this translates to a Manning's 'n' value of between 0.15 and 0.2. In a 100-year ARI event, the value will be lower and can be assumed to be 0.03.
- Swale Longitudinal slope: Between 2 and 4 per cent in order to promote uniform flow conditions across the swale. Slopes outside this range ie. <2% slope - use filter media below the swale to increase filtration rates, >5% slope - use checks dams to spread flow and reduce flow velocity through the swale.
- Swale width: Should not exceed 2.5m, unless check-dams or other structural measures are employed to ensure a uniform spread of flow.
- Geometry: Parabolic or trapezoidal shapes in order to minimise corners, with slopes at maximum of 3:1 (h:v).

Steps Involved in Swale Design

1. Estimate the design flow for the design storm event and confirm it falls within the requirements above.
2. Determine the slope of the filter strip. (MUSIC: 'Bed Slope [%]')
3. Set the design flow depth (MUSIC: 'Depth')
4. Solve Manning's Equation to determine the width of flow. (Mowed grass 0.2, natural or infrequently mowed grass 0.24).
5. Determine the flow area. (Using the flow width and established depth).
6. Calculate the resultant flow velocity. Reduce the flow, increase the flow width or reduce the depth of flow if the velocity exceeds 0.3m/s.
7. Calculate the flow length using the resulting velocity, to achieve a residence time of nine (9) minutes. (Absolute minimum residence should be 5 minutes to keep in accordance with Best Practice) (MUSIC: 'Length')

Design Factors That May Impede Performance

- Only limited removal of fine sediments and dissolved pollutants;
- High flows and high flow depths reduce effectiveness;
- Limited application in shaded areas;
- Only suitable for gentle slopes (less that 5%); for steeper slopes check dams are required.

- Regular inspections required
- Attempts to maintain sheet flow (even depth of flow over the area) over the length of the swale may require further engineering to input flow paths.

Trapping Performance

Grass swales can achieve high removal rates, although limited Australian data exists. An example of data obtained by Horner et al (1994) is below:

Pollutant	**Retention (%)**	**Pollutant**	**Retention (%)**
Suspended Solids	83	Lead	67
Oil & Grease	75	Total Phosphorous	29
Iron	72	Total Nitrogen	Negligible
Pollutant Retention rates for filter strips			

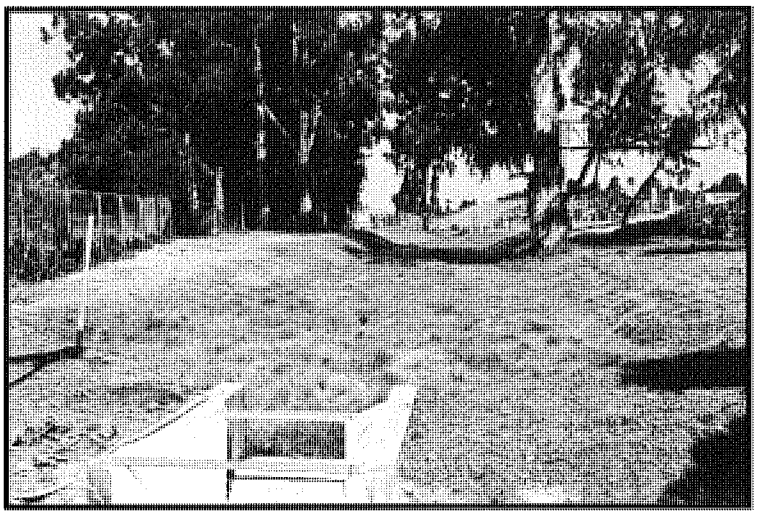
Design Considerations

- Swales adjacent to roads may be compacted by vehicular traffic, which may cause reduced infiltration rates.
- Higher than design flows can cause erosion to the swale in addition to scouring. For such events a bypass system should be installed.

Computer Evaluation of Water Quality Treatment Effectiveness

Model for Urban Stormwater Improvement Conceptualisation (MUSIC)
MUSIC is a computer aid to decision making. It enables users to evaluate conceptual designs of stormwater management systems to ensure they are appropriate for their catchments. (*MUSIC User manual Version. 1*)
Previous methods of sizing of a swale were based purely on hydraulic requirements and did not take into account the subsequent water quality effects. The parameters from the hydraulic calculations can be directly transferred to MUSIC to determine the water quality effect that this swale will have in the treatment train.

Vegetated Swale TC-30



Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

CASQA
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- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft². This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft², which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.85 / 1,000 ft^2/ mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	$9.00 / 1,000 ft^2/ year	$0.18 / linear foot	$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	$0.30 / yd^2	$0.01 / linear foot	$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.15 / linear foot / year, plus $25 / inspection	$0.15 / linear foot	$0.15 / linear foot	Inspect four times per year
Total	--	**$0.58 / linear foot**	**$ 0.75 / linear foot**	–

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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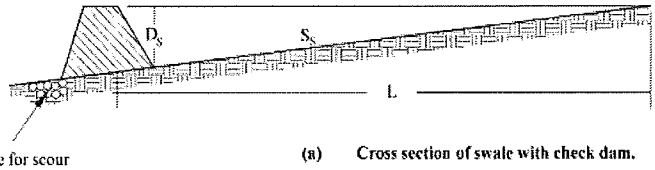
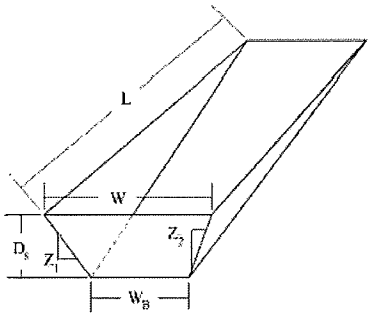


Provide for scour protection.

(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:

L = Length of swale impoundment area per check dam (ft)
D_S = Depth of check dam (ft)
S_S = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

Chapter Six
Types of Vegetative Biofilters and Their Ability to Remove Pollutants

6.1 Introduction

Historically vegetative biofilters, such as grass swales, were used primarily for stormwater conveyance (Ree, 1949; Chow, 1959; Temple, 1987). However with the passage of the Clean Water Act, and the focus on water quality management of urban runoff, the potential for the application of these techniques has begun to be reconsidered and many additional benefits have been identified. Today biofilters are being applied to address design objectives of urban stormwater management. These include: reduction of urban runoff impacts, groundwater recharge, water quality control, stream channel protection, and peak discharge control for both small storms (6-month and 1-year frequency storms), and large storms (2, 10 and 100-year storms). The most common application of the biofilters, however, is typically their use as the first stage of the treatment train approach and their purpose is to partially address groundwater recharge and water quality control for small headwater areas.

Three different types of vegetative biofilter BMP types have been identified and are described in this document. These are: grass swales, vegetated filter strips, and bioretention cells. Grass swales include three variations: traditional grass swales, grass swales with media filters and wet swales.

6.2 Grass Swale

Grass swales have traditionally been used as a low cost stormwater conveyance practice in low-to-medium density residential developments (e.g., ½- acre lots). Most public works agencies throughout the U.S. have a typical rural road sectional that allows the use of vegetated swales within the public right of way. During the early years of stormwater management technology the focus was on peak discharge control and grass swales were not given much consideration. As the focus of stormwater management programs expanded to include water quality considerations and pollutant reduction, the grassed swale has been perceived to represent

a potentially important element of the treatment train approach to total stormwater management (Yousef, et al, 1986; Yu, 1992; Yu, 1993).

Grass swales have a number of desirable attributes with respect to total stormwater management (MDE, 2000; ASCE, 1998; CRC, 1996; Yu, 1993;) including:

- slower flow velocities than pipe systems that result in longer times of concentration and corresponding reduction of peak discharges;
- ability to disconnect directly connected impervious surfaces, such as driveways and roadways thus reducing discharge;
- filtering of pollutants by grass media;
- infiltration of runoff into the soil profile thus reducing discharges, providing additional pollutant removal, and increasing groundwater recharge; and
- uptake of pollutants by plant roots (phytoremediation)

A typical grass swale is shown in Figure 6-1. The section shows that the water quality volume (WQv) is a fraction of the typical 2 and 10 year design storms.

Grass Swale with Media Filters Also known as a dry swale, this grass swale consists of an open channel that has been modified to enhance its water quality treatment capability by adding a filtering medium consisting of a soil bed with an underdrain system (CRC, 1996). It is designed to temporarily store the design water quality volume (WQv) and allow it to percolate through the treatment medium. The system is designed to drain down between storm events within approximately one day. The water quality treatment mechanisms are similar to bioretention cells except that the pollutant uptake is likely to be more limited since only a grass cover crop is available for nutrient uptake.

Wet Swale The wet swale also consists of a broad open channel capable of temporarily routing and storing the water quality volume (WQv) but does not have an underlying filtering bed (CRC, 1996). It is constructed directly within existing soils and may intercept the water table. Like the dry swale, the WQv within the wet swale should be stored for approximately 24 hours. The wet swale has water quality treatment mechanisms similar to stormwater wetlands, both of which rely primarily on settling of suspended solids, adsorption, and uptake of pollutants by vegetative root systems. Figure 6-2 illustrates the design components of the wet swale (MDE, 2000).

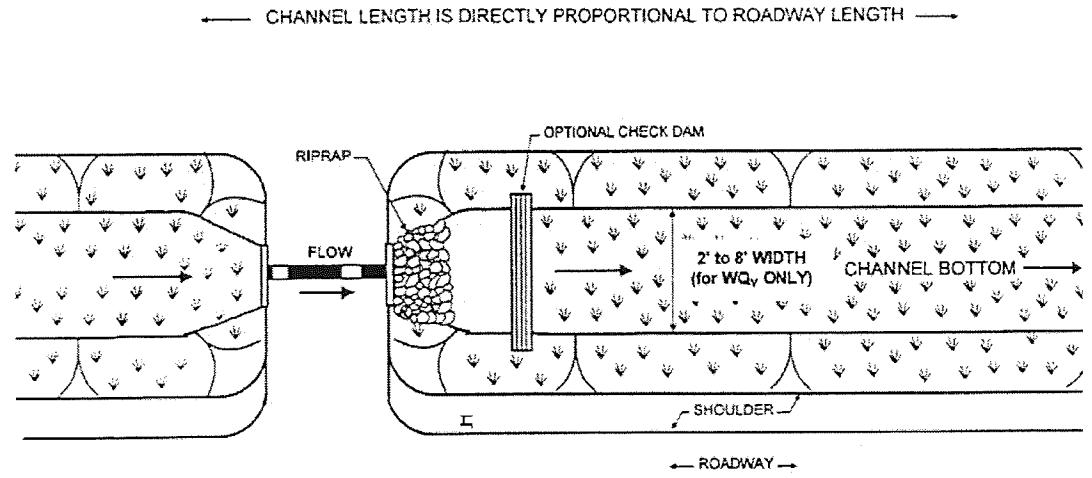


Figure 6-1 Grass Swale (MDE, 2000)

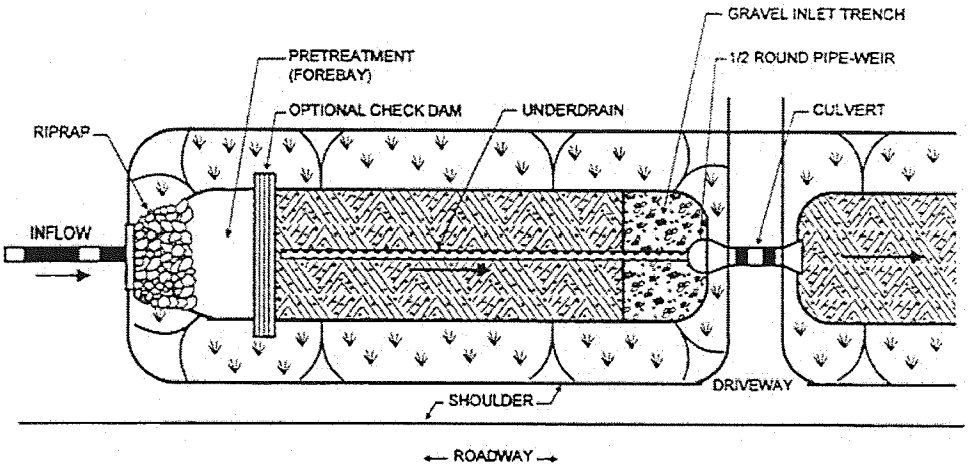


Figure 6-2 Wet Swale (MDE 2000)

6.3 Vegetative Filter Strip

Vegetative filter strips (VFSs) and buffers are areas of land with vegetative cover that are designed to accept runoff as overland sheet flow from upstream development. They can either be constructed or existing. Dense vegetative cover facilitates sediment attenuation and pollutant removal for the design storms. Unlike grass swales, vegetated filter strips are primarily designed for overland sheet flow. Grading and level spreaders can be used to create a uniformly sloping area that distributes the runoff evenly across the filter strip. For small storms that do not discharge, infiltration becomes the primary removal mechanism.

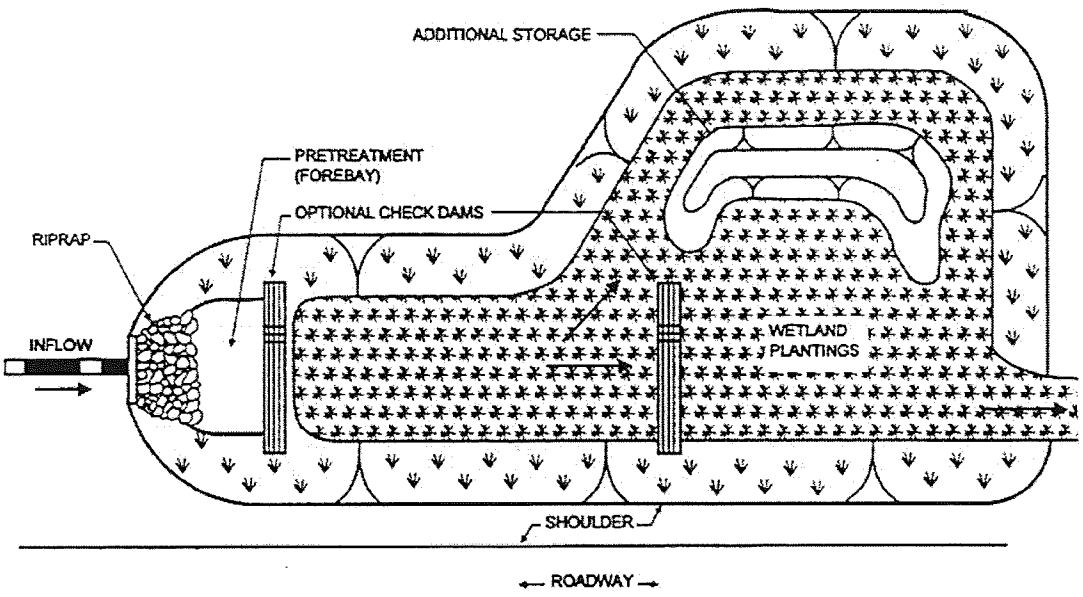
Filter strips have been used to treat runoff from roads and highways, roof downspouts, very small parking lots, and pervious surfaces. They can also be used as the "outer zone" of a stream buffer but are usually most effective as pretreatment to another treatment BMPs such as infiltration basins or trenches. Figure 6-3 illustrates the primary design components of the filter strip (CRC, 1996).

6.4 Bioretention Cell

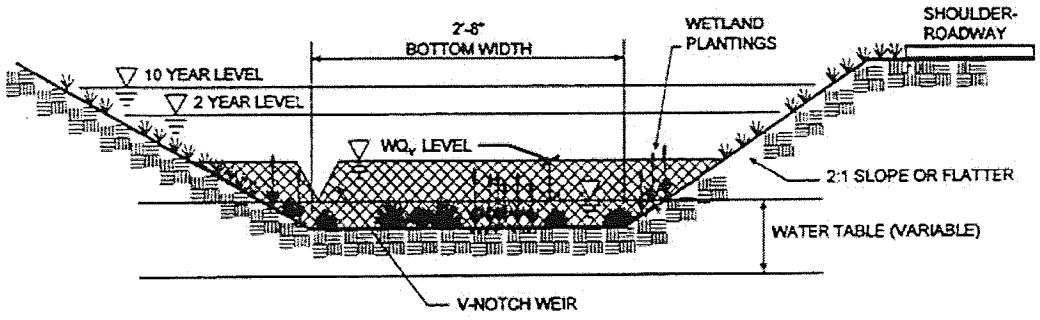
The bioretention concept was originally developed in the early 1990's as an alternative to traditional BMP structures (Clar, *et al.*, 1993, 1994). Bioretention is a practice to manage and treat stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The method combines physical filtering and adsorption with biological processes and usually takes place in a bioretention cell. The system consists of a flow regulation structure, a pretreatment filter strip or grass channel, a sand bed, a pea gravel overflow curtain drain, a shallow ponding area, a surface organic layer of mulch, a planting soil bed, plant material, a gravel underdrain system, and an overflow system. Figure 6-4 illustrates these primary design components of the bioretention cell (MDE, 2000).

6.5 Role in Water Quality Improvement

Table 6-1 summarizes the pollutant removal capability reported as percent removal of biofilter BMPs for the following constituents: TSS, total phosphorus (TP), total nitrogen (TN), Nitrates, (NO3), and metals. Biofilters have some similarities with respect to performance, but their flow reduction and pollution removal capabilities are basically a function of their size relative to the inflow drainage volume (or long-term infiltration capacity volume) ratio (volume/area). For example, all of these facilities typically report relatively high removal rates of suspended sediment, ranging from 68% for the grass channel to 90% or more for the dry swale and the bioretention cell. The bioretention cell is typically much smaller than the other units; therefore, the total loading would be smaller.



PLAN VIEW



PROFILE

Figure 6-3 Typical Vegetative Filter Strip (CRC, 1996)

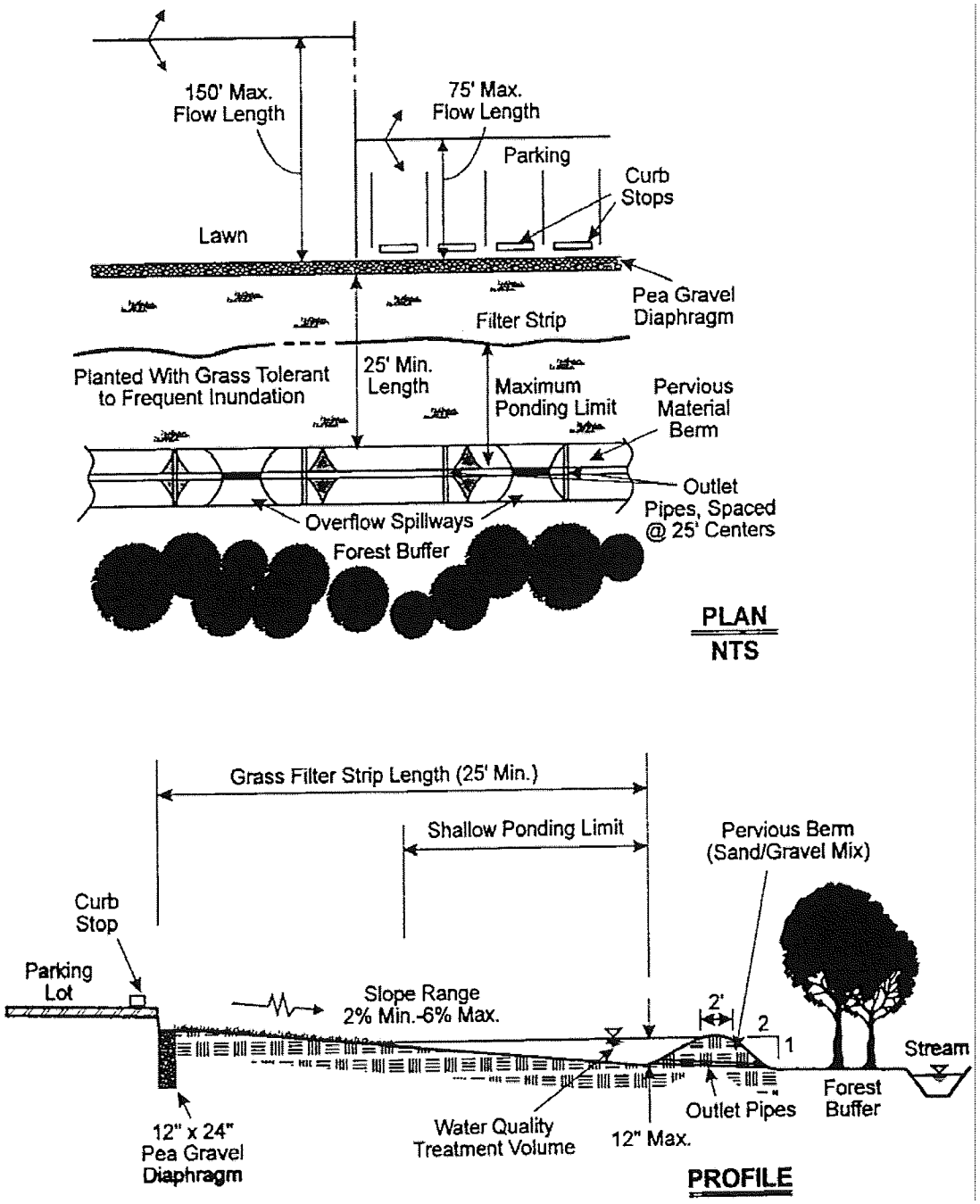


Figure 6-4 Typical Bioretention Cell (MDE, 2000)

Table 6-1 Estimated Pollutant Removal Capability of Biofilters (Winer, 2000; Yu and Kaighn, 1992, Davis et al., 1998)

Biofilter	TSS*	TP	TN	NO_3	Other / Comments
Grass Swale	68	29	N/A	-25	Metals: Cu (42); Zn (45) Hydrocarbons: 65% Bacteria: Negative
Dry Swale	93	83	92	90	Metals: Cu (70); Zn (86)
Wet Swale	74	28	40	31	Metals: Cu (11); Zn (33)
Filter Strip	70	25	NA	10	Metals: 40-50%
Bioretention	95	83	43	23	Metals: 93-99%

* Removals shown as percentages

Some differences have been observed in the comparative ability to remove total phosphorus. The best performers were the dry swale and bioretention cells with removal rates of 83% and 70% respectively. Grass channels, wet swales and filter strips were less reliable, at 10 to 29% average removal. Vegetative biofilters display a wide range of total nitrogen removal. The dry swale exhibited a very high removal rate of 92%.

While all biofilter designs showed at least moderate capacity to remove trace metals such as copper, lead, and zinc, most of the removed metals were already attached to particles. Designs that showed promise in removing dissolved metals include the dry swale and bioretention cell.

Pollutant removal and mechanisms rely on processes in a generally aerobic environment, as opposed to anaerobic environment. Filters which go anaerobic tend to release previously captured phosphorous as iron phosphates break down.

Compatibility with Land Use Type As a group, vegetative biofilters can be applied to a diverse range of land use types. However, individual designs are limited to a much narrower range. These common land use situations include ultra-urban sites, parking lots, road and streets, small residential subdivisions and backyard/rooftop drainage. Table 6-2 is a matrix that illustrates the most economical and feasible biofilter designs for each of these five broad categories of development, as well as those that are not applicable. As previously discussed, devices that rely on infiltration should take into consideration the fate of possible pollutants in the groundwater.

Table 6-2 Land Use and Biofilter Suitability

Urban Retrofit	Bioretention cell has proven very versatile for use in retrofit conditions. Swales are usually not well suited.
Parking Lots	Bioretention cell is well suited for use in parking lots. Swales may be suitable under certain conditions (space, soils, water table). Filter strips can be effective (Figure 6-1)
Roads & Highways	City streets generally do not provide enough space for any biofilter Suburban areas, specially large to medium lot subdivision can accommodate all of the biofilters. Highways may accommodate biofilters if sufficient space is available in median or side slopes.
Residential	Low density residential affords opportunities for all biofilter uses. High density residential may offer limited opportunity based on space availability.
Rooftops	Roof drain disconnections to filter strips or bioretention areas are recommended where feasible.

For example, in ultra-urban or retrofit settings where space is at a premium, the bioretention cell is one of the most versatile biofilters. In most cases, the space requirements of swales and filter strips are so great that they can be eliminated from consideration in downtown urban areas, but bioretention cells may be considered as a retrofit to partially treat urban runoff.

Compatibility with Site Conditions Table 6-3 compares how each biofilter design compares with respect to a number of site conditions, including soils, water table, drainage area, slope head and space consumed.

6.6 Design of Grass Swales for Pollutant Removal

Pollutants are removed in swales by settling, deposition in low velocity areas, or by infiltration into the subsoil. The primary pollutant removal mechanism is through sedimentation of suspended materials for larger particles and infiltration for colloidal particles and dissolved solids. Therefore, suspended solids and adsorbed metals are most effectively removed through the traditional grass swale (rather than the swale with filter media or wet swale). Removal efficiencies reported in the literature vary, but generally fall into the low-to-medium range, with some swale systems recording no water quality effects at all. Schueler (1992), reported that of 10 swales monitored, 50 percent registered moderate pollutant removal, while the remainder showed negligible or negative removal.

The amount of pollutant removed will depend on the length of the swale. Table 6-4 presents the pollutant removal efficiencies for 200 ft and 100 ft swale lengths. Although research results varied, these data clearly indicate increased pollutant removal efficiencies with longer swales.

Table 6-3 Physical Site Conditions and Biofilter Suitability (modified from MDE, 2000)

Biofilter	Soils	Water Table (depth)	Drainage Area (acres)	Slope Limits	Head	Area Required
1) Grass Swale	OK	2 feet	5 max	6% max.	2 feet	6.5%
Dry Swale	Filter Media	2 feet	5 max	6% max	3 to 6 feet	10-20%
Wet Swale	OK	Below WT	5 max	6% max	1 foot	10-20%
2) Filter strip	OK	2 feet	N/A	15% max	N/A	100%
3) Bio-retention Cell	Filter Media	2 feet	2 max	None	5 feet	5.0%

Notes: Soils - the key evaluation factors are based on an initial investigation of the USDA HSG at the site. More detailed geotechnical tests are usually required for infiltration feasibility and during design to confirm permeability and other factors

Water table - the minimum depth to the seasonally high water table from the bottom or floor of a BMP.

Drainage Area - the recommended minimum or maximum drainage area that is considered suitable for the practice. If the drainage area present at a site is slightly greater than the maximum allowable drainage area for a practice, some leeway is permitted or more than one practice can be installed.

Slope Restriction - the effect of slope on the practice. Specifically, the slope restrictions refer to how flat the area where the practice may be.

Head - an estimate of the elevation difference needed at a site (from the inflow to the outflow) to allow for gravity operation within the practice.

Area Required - indicates percentage of total drainage area requirement for BMP.

Table 6-4 Pollutant removal efficiencies for grass swales (Barret, et al., 1993; Schueler, 1991; Yu,1993; Yousef, et al,, 1985; Horner, 1996)

Design	Pollutant Removal Efficiencies (%)							
	Solids	Nutrients		Metals			Other	
	TSS	TN	TP	Zn	Pb	Cu	Oil & Grease	COD**
200-ft grass swale	83	25*	29	63	67	46	75	25
100-ft grass swale	60	0	45	16	15	2	49	25

*Some swales, particularly 100-ft systems, showed negligible or negative removal for TN.

**Data is very limited.

In general, the current literature reports that a well-designed, well-maintained swale system can be expected to remove 70% of total suspended solids (TSS), 30 percent for total phosphorus (TP), 25 percent for total nitrogen (TN), and 50 to 90% for trace metals (Barret, et al., 1993; GKY, 1991). The TN removals may be fairly optimistic, given that studies conducted by Yousef et al. (1985) and others produced negative nitrogen removal in many cases, possibly due to the remobilization of nitrogen from grass clippings and other organic materials.

Seasonal differences in swale performance can be important. In temperate climates, fall and winter temperatures force vegetation into dormancy, thereby reducing uptake of runoff pollutants, and removing an important mechanism for flow reduction. Decomposition in the fall, and the absence of grass cover in the winter can often produce an remobilization of nutrients, and may expose the swale to erosion during high flows, increasing sediment loads downstream. Pollutant removal efficiencies for many constituents can be markedly different during the growing and dormant periods (Driscoll and Mangarella, 1990).

6.7 Design of Vegetative Filter Strips for Pollutant Removal

Pollutants are removed in filter strips mainly by settling for larger particles and by soil infiltration for colloidal particles. Under low-to-moderate velocity, filter strips effectively reduce particulate pollutant levels by removing sediments and organic materials and trace metals (Schueler, 1992). Research has shown removal of 70% for TSS, 40% to 50% for phosphorus (particulate) and zinc, 25% for lead, and 10% for nitrate/nitrite (Florida Department of Transportation, 1994). Settling of aggregate containing clay particles removes sorbed nutrients and other pollutants. Removal of free soluble pollutants in filter strips is accomplished when pollutants infiltrate into the soil, some of which are subsequently taken up by rooted vegetation. Therefore, removal of solubles depends on the infiltration rates. The mechanism for infiltration is minor in most filter strips during design storms or larger storms since only a modest portion of the incoming runoff is infiltrated and most discharges, resulting in low removal rates for solubles, but is the dominant mechanism for small storms that totally infiltrate.

Pollutant removal in filter strips is a function of length, slope, soil permeability, size of contributing runoff area and its long-term contributing inflow volume, particle size and settling velocity, and runoff velocity (Schueler, 1987 and Hayes et al., 1984). A wide range of values for minimum length in the flow direction have been reported in the literature. Frequently cited values range from 20 ft to lengths of 100 to 300 ft for adequate removal of the smaller particles. The design guidance that follows provides analytical procedures for computing these values.

Regardless of vegetation type, the length of the filter strip is shown to have significant influence on pollutant removal. Figure 6-5 provides one example of percent pollutant removal efficiency versus length (Yu and Kaighn, 1992). In Figure 6-5, the relative value of adding additional length to a filter strip for pollutant removal levels off significantly after 59 ft, with the most significant rise in removal occurring between 19 to 59 ft. However, strip length alone does

not entirely define pollutant removal. The existing longitudinal slope and soil infiltration capacity will also influence the ultimate length of the system. These factors may dictate a strip longer than would be necessary if pollutant removal alone was the only consideration.

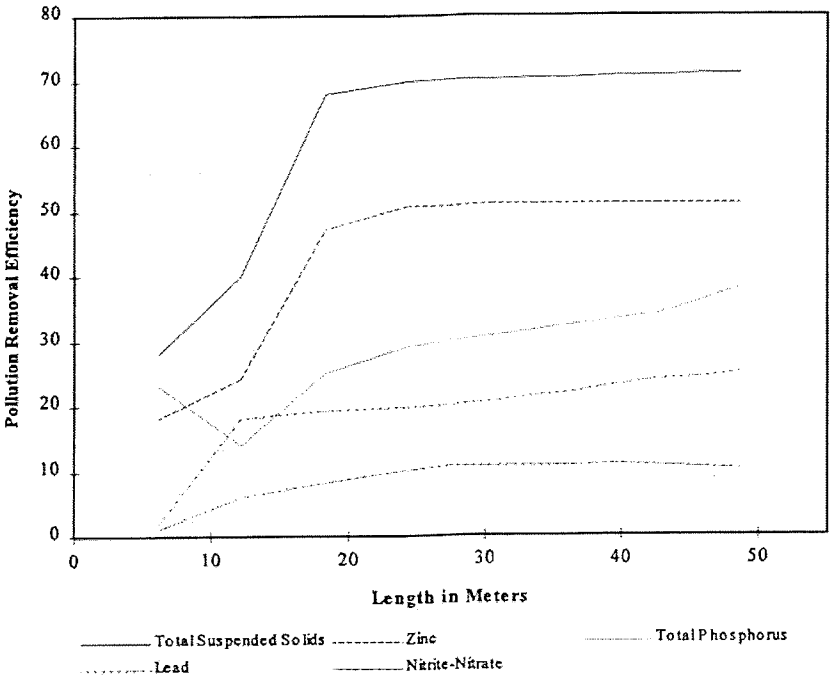


Figure 6-5 Pollutant Removal Efficiency Versus Filter Strip Length
(Yu and Kaighn, 1992)

In design, the variables that can be effectively manipulated include length and slope of the strip, soil characteristics and vegetative cover. According to Yu and Kaighn (1992), optimum lengths were between 20 to 30 m for a given sheetflow over the filter strip and inflow to outflow pollutant removals. Higher pollutant removal rates for longer lengths were feasible; however, further improvements in pollutant removal are relatively minor. The design length would be expected to vary widely with slope, settleable particle size, soil type, infiltration capacity and vegetation type. Avoiding the potential for concentrated flows and "gullies" will effectively "short-circuit" the filter strip and significantly reduce removal rates. Width can also influence pollutant removal but is often constrained by the area available.

VFS Enhancements - Level Spreader A level spreader should be provided at the upper edge of a vegetated filter strip when the width of the contributing drainage area is greater than that of the filter. Runoff may be directed to the level spreader as sheet flow or concentrated flow. However, the design must ensure that runoff fills the spreader evenly and flows over the level lip

as uniformly as possible. The level spreader should extend across the width of the filter, leaving only 10 feet open on each end.

There are many alternative spreader devices, with the main consideration being that the overland flow spreader be distributed equally across the strip. Level spreader options include porous pavement strips, stabilized turf strips, slotted curbing, rock-filled trenches, concrete sills, or plastic-lined trenches that act as a small detention pond (Yu and Kaighn, 1992). The outflow and filter side lip of the spreader should have a zero slope to ensure even runoff distribution (Yu and Kaighn, 1992). Once in the filter strip, most runoff from high storm flow events will not be infiltrated and will require a collection and conveyance system. Grass-lined swales are often used for this purpose and can provide another BMP level. A filter strip can also drain to a storm sewer or street gutter (Urbonas, 1992).

VFS Enhancements - Pervious Berm A pervious berm may be installed at the foot of the strip to force ponding in a VFS. It should be constructed using a moderately permeable soil such as ASTM ML, SM, or SC. Soils meeting USDA sandy loam or loamy sand texture, with a minimum of 10 to 25% clay, may also be used. Additional loam should be used on the berm (± 25%) to help support vegetation. An armored overflow should be provided to allow larger storms to pass without overtopping the berm. Maximum ponding depth behind a pervious berm should be 1 foot.

VFS Enhancements - Types of Vegetation to Use A VFS should be densely vegetated with a mix of erosion resistant plant species that effectively bind the soil. Certain plant types are more suitable than others for urban stormwater control. The selection of plants should be based on their compatibility with climate conditions, soils, and topography and the their ability to tolerate urban stresses from pollutants, variable soil moisture conditions and ponding fluctuations.

A filter strip should have at least two of the following vegetation types: deep-rooted grasses and ground covers; or deciduous and evergreen shrubs; or under- and over-story trees. Native plant species should always be specified . This will facilitate establishment and long term survival. Non-native plants may require more care to adapt to local hydrology, climate, exposure, soil and other conditions. Also, some non-native plants may become invasive, ultimately choking out the native plant population. This is especially true for non-native plants used for stabilization.

Newly constructed stormwater BMPs will be fully exposed for several years before the buffer vegetation becomes adequately established. Therefore, plants which require full shade, are susceptible to winter kill or are prone to wind damage should be avoided. Plant materials should conform to the American Standard for Nursery Stock, current issue, as published by the American Association of Nurserymen. The botanical (scientific) name of the plant species should be according to the landscape industry standard nomenclature. All plant material specified should be suited for USDA Plant Hardiness Zones.

Grassed filter strips should be constructed of dense, soil-binding deep-rooted water-resistant plants. Dense turf is needed to promote sedimentation and entrapment, and to protect against erosion (Yu and Kaighn, 1992). Turf grass should be maintained to a blade height of 50 to 60 mm (2 to 4 in). Most engineered, sheet-flow systems are seeded with specific grasses. Common grasses established for filter strip systems are rye, fescue, reed canary, and Bermuda (Horner, 1996). Tall fescue and orchard grasses grow well on slopes and under low nutrient conditions (Horner, 1996). The grass species chosen should be appropriate for the climatic conditions and maintenance criteria for each project.

Retaining existing trees and woody vegetation have been shown to increase infiltration and improve performance of filter strips. Trees and shrubs provide many stormwater management benefits by intercepting some rainfall before it reaches the ground, and improving infiltration and retention through the presence of a spongy, organic layer of materials that accumulates underneath the plants (Schueler, 1987). As discussed previously in this section, wooded strips have shown significant increases in pollutant removal over grass strips. Maintenance for wooded strips is lower than grassed strips, another argument for using trees and shrubs. However, there are drawbacks to using woody plants. Since the density of the vegetation is not as great as a turf grass cover, wooded filter strips need additional length to accommodate more vegetation. In addition, shrub and tree trunks can cause uneven distribution of sheet flow, and increase the possibility for development of gullies and channels. Consequently, wooded strips require flatter slopes than a typical grass cover strip to ensure that the presence of heavier plant stems will not facilitate channelization.

Filter strips managed to allow "natural succession" of vegetation from grasses to shrubs and trees provides excellent urban wildlife habitat. Judicious planting of selected native shrub and trees can be used to enhance the quality of food and cover for a variety of animal species (Schueler, 1987). Compaction of soils during construction may not be appropriate for planting of shrubs and trees as growth of a healthy root structure may be inhibited. To facilitate this approach, a landscaping plan should be included in the project specifications.

Construction Guidelines Overall, widely accepted construction standards and specifications, such as those developed by the USDA Natural Resources Conservation Service or the U.S. Army Corps of Engineers, should be followed where applicable to construct a vegetated filter strip. The specifications should also satisfy all requirements of the local government.

Sequence of Construction Vegetated filter strip construction should be coordinated with the overall project construction schedule. Rough grading of the filter strip should not be initiated until adequate erosion controls are in place.

6.8 Design of Bioretention Cells for Pollutant Removal

Since this is a relatively new BMP, the available data on the pollutant removal performance of bioretention cells is scarce. The preliminary reports from field monitoring activities (Table 6-5) are verifying that this BMP not only met local water quality control criteria, but actually ranked as one of the most effective pollutant removal BMPs available. Percent removals will depend on filter media used, influent pollution concentrations, hydraulic loadings and other factors.

Table 6-5 Pollutant Removal Performance of Bioretention Practices (% Removal) (Davis et al, 1997)

	Cu	Pb	Zn	P	TKN	NH_4	NO_3	TN
Upper Zone	90	93	87	0	37	54	-97	-29
Middle Zone	93	99	98	73	60	86	-194	0
Lower Zone	93	99	99	81	68	79	23	43

The University of Virginia, Charlottesville, Virginia has initiated a long term study of the performance of a bioretention cell. This study differs from the two bioretention studies conducted in Maryland that monitored a single storm event (3 inches of rainfall). The UVA study is providing performance data based on an annual hydrologic budget. Initial, first year results indicate that the performance of the bioretention cells will exceed all expectations. First year removal results are as follows: 86% for TSS, 90% for TP, 97% for COD and 67% for oil and grease (Yu, et al. 1999).

Unlike the other vegetative biofilters that have a dual function of stormwater transport or detention and pollutant removal, bioretention cells primary function is pollutant removal. For this reason, bioretention cells would perform best as part of a treatment train. Bioretention can also be an effective retrofit BMP for existing urban areas that already have stormwater drainage systems.

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(858) 694-2212 FAX: (858) 268-0461
Web Site: sdcdpw.org

November 28, 2005

Stewart McClure
Clearwater Solutions, Inc.
2259 Lone Oak Lane
Vista, Ca 92084

Dear Mr. McClure:

CLEARWATER SOLUTION FOR USE IN THE COUNTY OF SAN DIEGO

The County of San Diego (County) has reviewed your inquiry regarding the approval of ClearWater Solution™ Best Management Practice (BMP) for use in the County of San Diego.

Since the County regulates the use of structural treatment control BMPs only in the unincorporated portions of the County, this response has no applicability to projects located within incorporated cities in the County. Furthermore, the County does not endorse this product.

After reviewing the information provided to the County, ClearWater Solution™ BMP shall be accepted for use as a structural treatment BMP under the category of filtration system. This decision is based on test results from San Diego State University.

Thank you for informing the County about your product. If you have any questions or need additional information, please contact Cid Tesoro, Flood Control Engineer, at (858) 694-3672, or e-mail at Cid.Tesoro@sdcounty.ca.gov.

Sincerely,

for CHANDRA L. WALLAR
Assistant Director

cc: Cid Tesoro (O326)

The ClearWater BMP Curb Inlet Filter

The ClearWater BMP is a powerful advancement in sidewalk curb inlet filtration technology. The patent-pending, filter train design allows stormwater flows to be screened, settled, and then filtered, all within the confines of an existing curb inlet drain box. This aggressive filtration design significantly reduces concentrations of trash, sediment, hydrocarbons, metals, and nutrients. Specifically designed for retrofitting within the existing curb and gutter infrastructure, it handles heavy storm flows with ease, dry-weather flows expertly, utilizes mosquito free technology and requires no excavation or concrete modification. The ClearWater BMP truly is your curb inlet pollution solution.

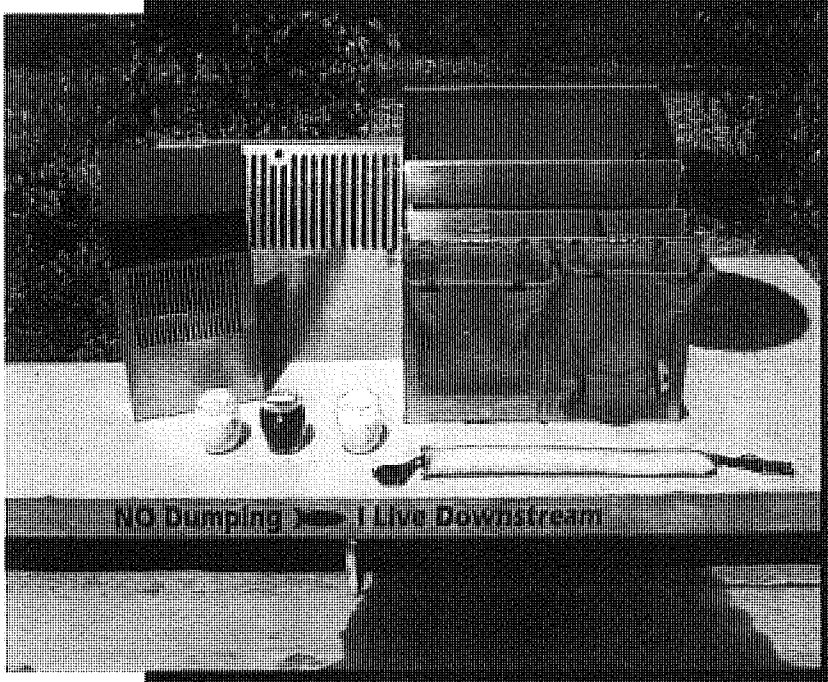
Features

- Fits into existing curb inlets
- Non-scouring
- Large storage capacity
- Easy street level maintenance
- No clogging under heavy flows
- Durable stainless steel construction
- Affordable

Benefits

- Improves downstream water quality
- High removal rate of Total Suspended Solids – 97%
- Located close to pollutant sources
- Reduces concentrations of trash, sediment, hydrocarbons, metals and nutrients
- NPDES Compliant – now and in the future

ClearWater BMP



Patent Pending

ClearWater Solutions™

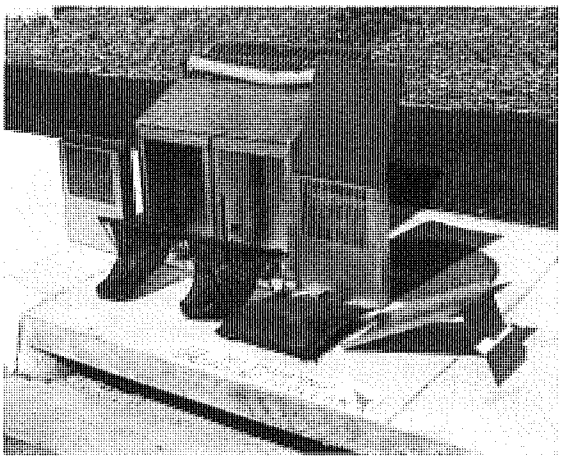
STORM DRAIN SPECIALISTS

2259 Lone Oak Lane • Vista, CA 92084

www.ClearWaterBMP.com

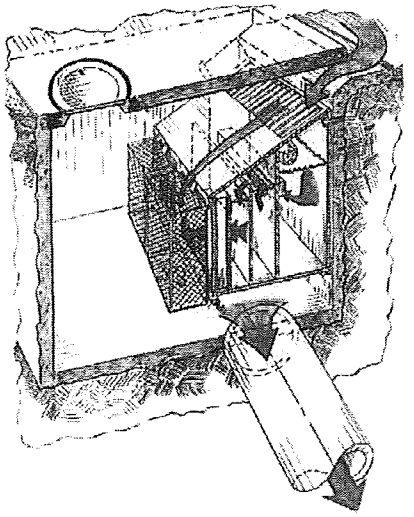
Toll Free: 800-758-8817 • F: 760-598-1371

System Operation



The ClearWater BMP is a powerful advancement in sidewalk curb inlet filtration technology. Specifically designed for retrofitting under the sidewalk within the curb and gutter system, it handles heavy storm flows with ease, utilizes mosquito free technology, and requires no excavation or concrete modification.

The revolutionary design of the ClearWater BMP allows storm water to be screened three times, settled three times, make constant surface contact with an oil and grease separator, pass through a synthetic mesh filter, and finally pass through a column of porous media comprised of natural zeolites, perlite, and activated carbon. Filter media can be tailored to site specific needs. These media and the unique engineering design of the filter support containing them, enhances removal of smaller particulates, thus improving the quality of life downstream.



Performance Testing

Using the "typical" storm water calculations of 0.2 inches (3,780 gallons) of rain per hour for an ordinary curb inlet, the ClearWater BMP performed very well. Proven testing from San Diego State University shows the ClearWater BMP has removal rates of 97% for total suspended solids (TSS), 86% for oil and grease (O & G), 81% for lead (Pb), and 83% for zinc (Zn). Satisfactory rates of removal were accomplished with heavy metals in solution, a claim that will not be found in most competitors literature since most only clean out larger settled constituents, while the finer materials flow downstream contaminating wildlife and beaches.

Removal with Mixed-Media Filter at 64 GPM

	"Typical" % Removal with ClearWater BMP
TSS: Total Suspended Solids	97
O&G: Oil & Grease	86
Pb: Lead	81
Zn: Zinc	83

What is your NPDES compliance criteria?

ClearWater BMP Treatment Capacity					
Rainfall Intensity, Inches/Hr.	0.20	0.25	0.50	0.75	1.0
R.O.W. Treatment Capacity, Acres	2.5	2.0	1.0	0.67	0.50

200 GPM (.46 CFS) before bypassing occurs.

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WHAT IS YOUR NPDES COMPLIANCE CRITERIA?

Typical Street Right-of-way for:

ClearWater BMP Treatment Capacity

Rainfall Intensity, Inches/Hr	0.20	0.25	0.50	0.75	1.0
R.O.W. Treatment Capacity, Acres	2.5	2.0	1.0	0.67	0.50

*** treatment capacity = 200 gpm before flow bypassing occurs .46 cfs**

ClearWater BMP Design Consideration	Feature Specifications	Benefits
Targeting Urban Retrofit and New Development: Impervious surface runoff capture and treatment area equivalent .	Filters up to 1.5" of rain per hour. At .50" of rain per hour unit can handle 43,560 square feet of drainage (1 acre).	Conserves land for other uses; optimizes land use where space is at a premium, e.g., urban retrofit.
Flow Thru Design Limits:		
Continuous flow-thru design limit	200 gpm (based on a 5/8" weir opening)	Exceeds NPDES criteria for "first flush".
Overflow flow-thru to flood system	250 gpm (based on a _" weir opening)	No clogging of stormdrains.
Primary Chamber Capacity	Coarse Settling 5.5 cf capacity	Cover and Back-panel Baffle ensures that it never scours/re-suspends sediments.
Secondary Chamber Capacity	Fine Settling	_" to 5/8" submerged neck-down between chambers ensures stilling and sedimentation.
Final Chamber	Soluable Filtering	Soluable Filtration including Bacteria.
Filter Media: • Perlite-zeolite mix • AbTec panel smart sponge (option) • Rubberizer oil-sock • Fish Filter pad	Targeting: • Metals, emulsified hydrocarbons, organics (chlorine, ammonia) • Pathogens • Floating hydrocarbons • Larger diameter suspended solids	• Pollution reduction at/near the source. • Removal efficiencies: 97% TSS, 86% Oil and Grease (O&G), 81% for lead (Pb), 83% for Zinc (Zn). • Satisfactory rates for heavy metals in solution.
Maintenance Requirements: • Filter media • Sediment removal	As required. Can be done from the curb using shop vac and generator or pumper truck.	Does not require sophisticated system. Is accessed from the curb.
Fabrication Materials	.304 gauge stainless steel, 16 GA	Won't corrode.
Outside Dimensions	30" wide; 30" high at rear-tapers to 20" at front, 34" front to back including trash hoops and nets.	
Assembly	Assembles inside existing drain box.	Can be retrofitted to older systems if box is large enough. Narrower Model is available.
Mosquito Free	Self-draining	Presents no health hazard.
Water Capture: 100% (at 200 gpm with 5/8" weir opening)	Design brings all water through the system; water tight seals between wall of drain box and filter.	Treats all water; captures all trash.

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The ClearWater BMP is a Filtration System!

Structural Treatment Control BMP Selection Matrix

Pollutant of Concern	Treatment Control BMP Categories						
	Biofilters	Detention Basins	Infiltration Basins	Wet Ponds or Wetlands	Drainage Inserts	**Filtration**	Hydrodynamic Separator Systems
Sediment	M	H	H	H	L	**H**	M
Nutrients	L	M	M	M	L	**M**	L
Heavy Metals	M	M	M	H	L	**H**	L
Organic Compounds	U	U	U	U	L	**M**	L
Trash & Debris	L	H	U	U	M	**H**	M
Oxygen Demanding Substances	L	M	M	M	L	**M**	L
Bacteria	U	U	H	U	L	**M**	L
Oil & Grease	M	M	U	U	L	**H**	L
Pesticides	U	U	U	U	L	**U**	L

(1) Including trenches and porous pavement.
(2) Also known as hydrodynamic devices and baffle boxes.

L: Low removal efficiency
M: Medium removal efficiency
H: High Removal efficiency
U: Unknown removal efficiency

Sources: Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993), National Stormwater Best Management Practices Database (2001), and Guide for BMP Selection in Urban Developed Areas (2001).

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

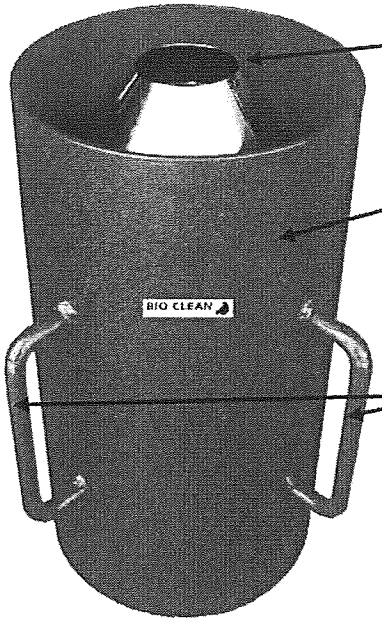
Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

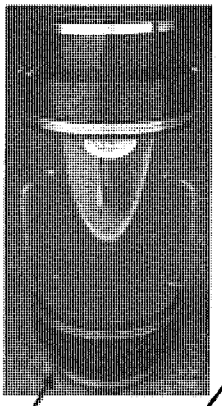
DOWNSPOUT FILTER



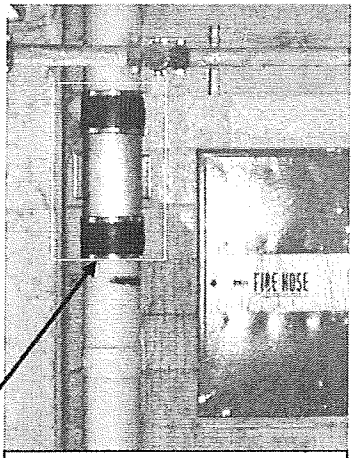
Internal Bypass System

Hydrocarbon Filter Media (inside)

Handles for easy removal and maintenance



Rubber Boots

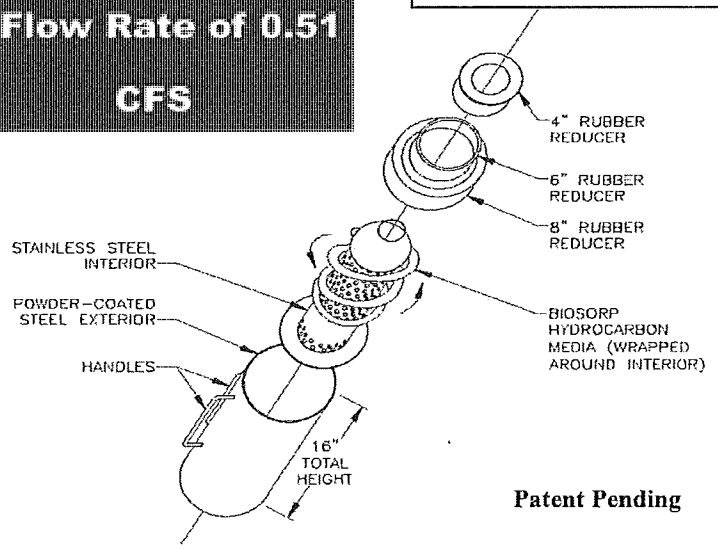


Filter Fits into Tight Locations for New or Retrofit Applications. This Filter Can Fit Where Others Can't.

Can Adapt to 4", 6" or 8" pipes.

The Unit Will Treat a Flow Rate of 0.51 CFS

- **Designed for Commercial and Industrial Buildings.**
- **Constructed of Powder Coated Steel.**
- **Made to fit most standard pipe sizes—custom sizing available upon request.**
- **Captures/Filters debris, sediments and Hydrocarbons.**
- **Internal bypass design for peak flows.**



Patent Pending

BIO CLEAN
ENVIRONMENTAL SERVICES. INC.™

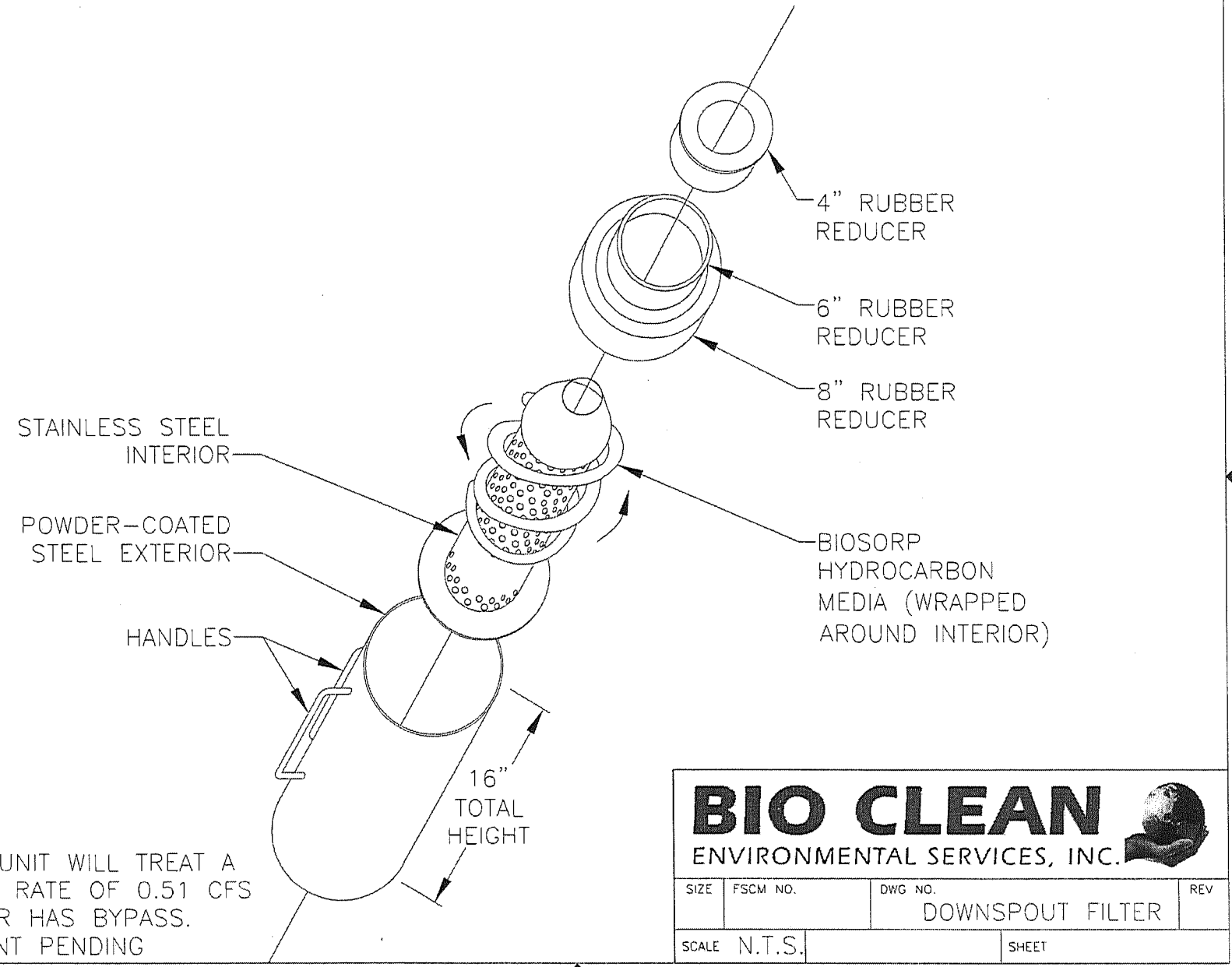
P.O. BOX 869
Oceanside, CA 92049

$700/ea

"The Stormwater Standard"

PHONE: 760.433.7640
FAX: 760.433.3176

Www.biocleanenvironmental.net



THE UNIT WILL TREAT A FLOW RATE OF 0.51 CFS FILTER HAS BYPASS. PATENT PENDING

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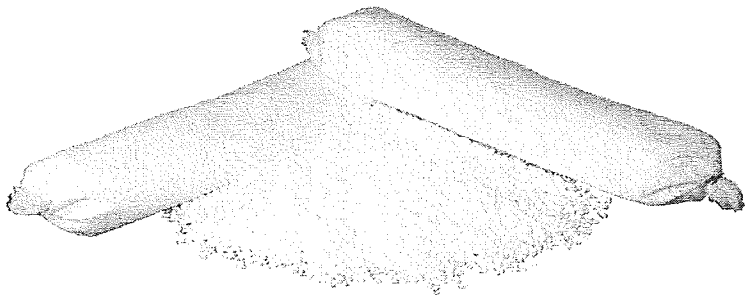
SIZE	FSCM NO.	DWG NO.	REV
		DOWNSPOUT FILTER	
SCALE N.T.S.		SHEET	

Bio-Sorb



Oil Absorbing Polymers

Our Bio-Sorb oil absorbing polymers are uniquely formulated to clean up...

- Spills
- Chemical Spills
- Fuel Oil Spills
- Diesel Oil Spills

Control and absorb oil and hydrocarbons on any surface – including water

- Control oil spills and slicks in harbor and dock areas
- Control oil contamination in municipal run-off
- Remove oil contamination from plant process water
- Clean-up fuel spills on highways
- Absorb hydrocarbon vapors and fumes

	TIME (seconds)	% Uptake	C
0	0.00	0.0000	
1	30.0	104.00	
2	60.0	107.00	
3	120	128.00	
4	180	155.00	
5	240	164.00	
6	300	168.00	

How Are Bio-Sorb Oil Absorbing Polymers Unique?

Bio-Sorb oil absorbing polymers function by first attracting hydrocarbons to the surface of the polymer to adsorb the liquid, followed immediately by internally absorbing the media into its structure. Bio-Sorb oil absorbing polymers will not absorb water, which lends the material a unique usefulness for separating and collecting hydrocarbons from water mixtures. Most notably, the polymer can commonly absorb from 20% to 200% or more of its own weight of chemical or petroleum derived liquids. Furthermore, because of the unique absorption characteristic of the material, Bio-Sorb becomes dry to the touch shortly after sorption.

For What Applications May Biosorb Oil Absorbing Polymers be Useful?

Potential applications for Bio-Sorb hydrocarbon absorbing materials are numerous as a result of their unique nature. One can imagine applications for commercial, industrial, defense and ecological markets.

- Stormwater Filters
- Concentrate Carrier Material for Liquid Additives
- Removing Oil or Chemicals from Contaminated Water Streams or Water/Soil Slurries
- Industrial Work Area Collection Mats
- Spill Containment and Collection
- Odor Barrier/Collector for Flavor Oils and Fragrances
- Collection of Volatile Organic Compounds (VOC's)
- Many Others

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FAX: 760.433.3176

SPECIFICATIONS

Downspout Filter

I. Specifications

Coverage: The Downspout Filter provides full treatment of influent stormwater, at rated flows, is conveyed to the filter. The filter will retain all debris, sediments and hydrocarbons entering the filter at specified flow rate.

Non-Corrosive Materials: All components of the filter system. Filter composed of exterior Powder Coated Steel, interior Stainless Steel and 4", 6" or 8" rubber boots to adapt to corresponding pipe sizing.

Durability: The Downspout filter is warranted for a minimum of five (5) years.

Oil Absorbent Media: The Filter is fitted with an absorbent media for removal of petroleum hydrocarbons from influent, and so placed in the filter assembly to treat influent at rated flow. Absorbent media is easily replaceable in the filter. The hydrocarbon media encompasses the total perimeter of the unit and wraps around the interior for maximum absorption.

Overflow Protection: The downspout filter is designed so that it does not inhibit storm flows entering the downspout, or obstruct flow through the downspout during peak storm flows.

Filter Bypass: Water will not bypass the Hydrocarbon Filter Media at low flows. The filter is designed with an Internal Bypass System in the center of the unit, which the flow will be diverted to during peak flows.

Pollutant Removal Efficiency: The downspout filter is designed to capture high levels of hydrocarbons, grease and oil. The filter will treat a Flow Rate of 0.51cfs.

II. Installation

Installation: The filter will be securely installed inline with existing piping, with contact surfaces sufficiently joined together. Filter is connected to piping with the use of 4", 6" or 8" rubber boots, secured with metal bands. All anchoring devices and fasteners are installed within the interior of inflow pipe. Bio Clean Environmental Services, Inc. Downspout Filter shall be installed in a vertical position, pursuant to the manufacturer's recommendations and the details on this sheet.

Installation Notes:

1. Remove rubber boots from both ends of the Downspout Filter.
2. Measure the exact height of the Downspout filter, approximately 16".
3. Cut the existing piping 1/4" longer than the exact height of the Downspout filter.
4. Place the rubber boots on the top and bottom of the existing pipe, sliding them all the way up and down, even with the pipe.
5. Using the handles of the Downspout Filter, place the filter in line with the existing pipe. Slide the rubber boots back in place over the filter and tighten the clamps securely.

III. Maintenance

Maintenance Notes:

1. Bio Clean Environmental Services, Inc. recommends cleaning and debris removal maintenance of twice a year and replacement of the Hydrocarbon Filter Media. Can be performed by facility maintenance crew.
2. The Downspout Filter can be cleaned by loosing the metal clamps at bottom and top of rubber boots. Remove the filter by grasping the handles, slide down the bottom boot over the outflow pipe and slide up the top boot over inflow pipe. Place the filter on the ground. Dispose of any trash and sediments collected in filter.
3. Once the filter is free, remove the interior insert. Remove the hydrocarbon boom by unwrapping it from the interior insert and replacing with a new boom, wrapping it the same way.
4. Place the interior insert back into the filter.
5. Place the filter back in line with the pipe and slide back the top and bottom boots in place and tighten the metal clamps securely.

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Nutrient Separating Baffle Box

Other Systems

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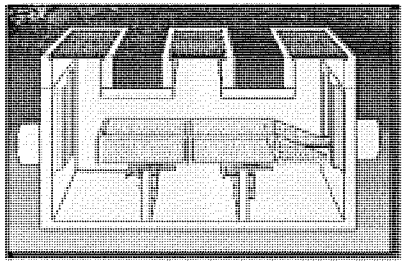
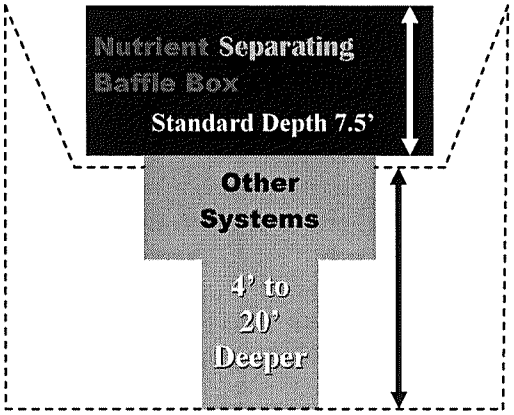
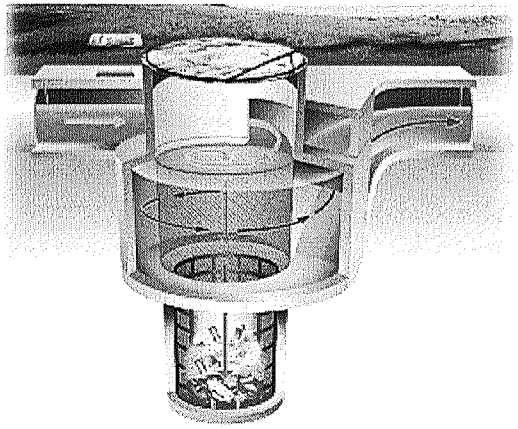
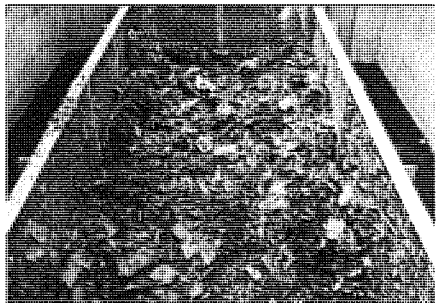


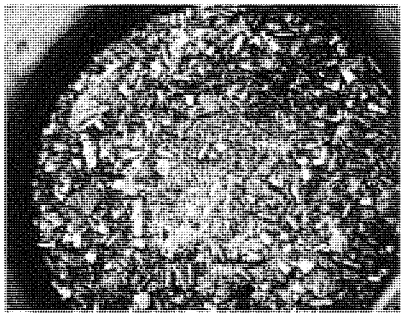
Shallow Profile





Separating these pollutants cuts down on maintenance costs and gives maintenance crews a two stage cleaning option.

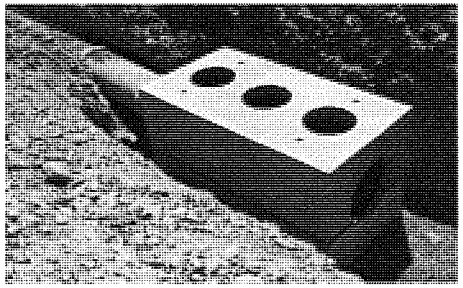


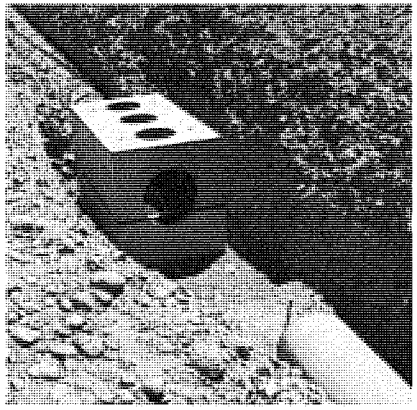


Organics and trash decomposing in the Water Held within this System.

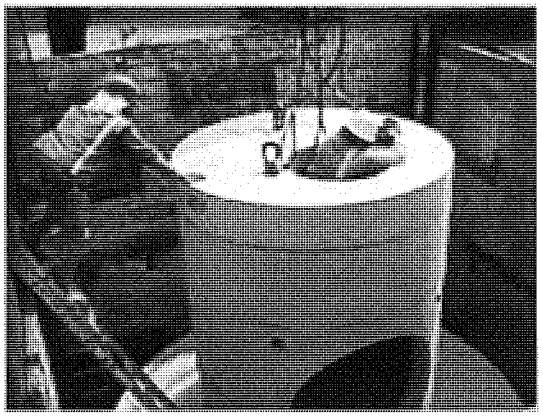
This leads to septic conditions. Dewatering of these pollutants also

This systems small footprint and shallow profile reduces excavation costs and cuts down on installation time.





High excavation and installation costs



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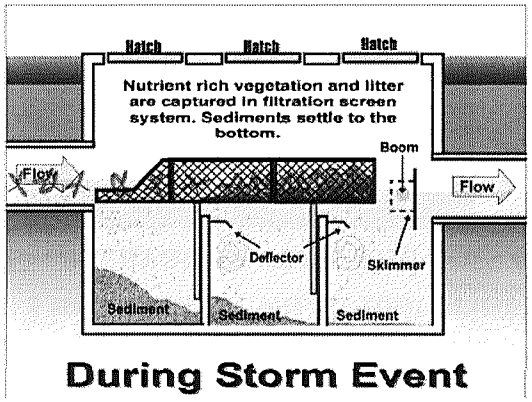
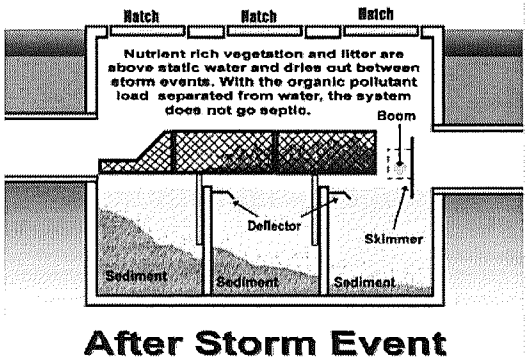
Nutrient Separating Baffle Box

"Separated from the Competition"



During Storm Event



After Storm Event

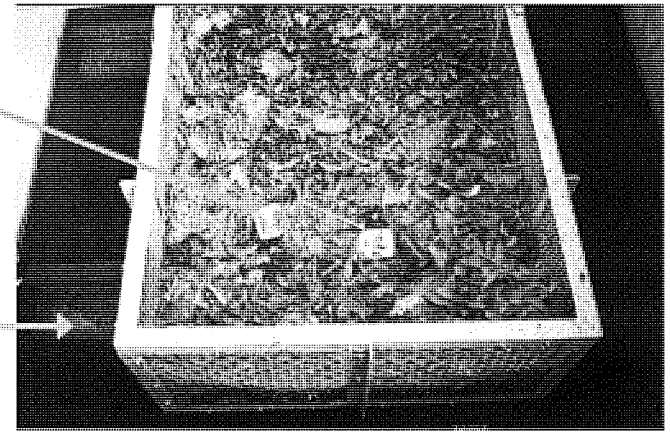
The Nutrient Separating Baffle Box Separates Organics (Debris) and Litter from the Standing Water.

Water is Clean and Clear

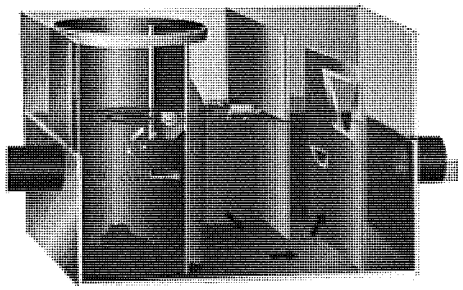
BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

Pollutants captured in upper screen are allowed to dry out between storm events.

Water has clear appearance. No Leeching Taking Place.



Other Systems



"When this debris is kept in a wet state, the nutrients will leach out and resuspend in the water column in a few days, becoming a source of nutrients pollution".
(ASCE Monitoring Guidelines for Measuring Stormwater Gross Solids: Stormwater Magazine, Nov/Dec 2005, page 10)

Figure 8. Percent Removal of TP.

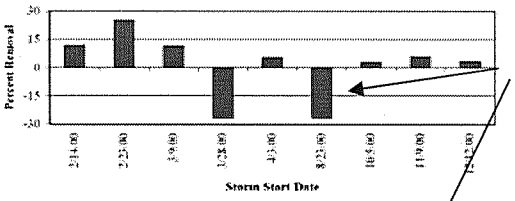
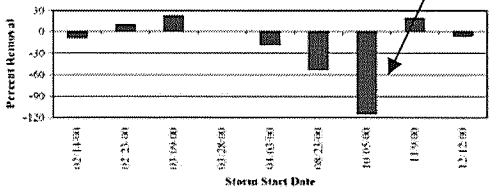
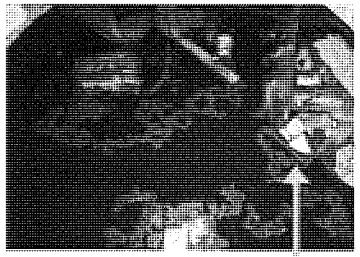


Figure 10. Percent Removal of TN.

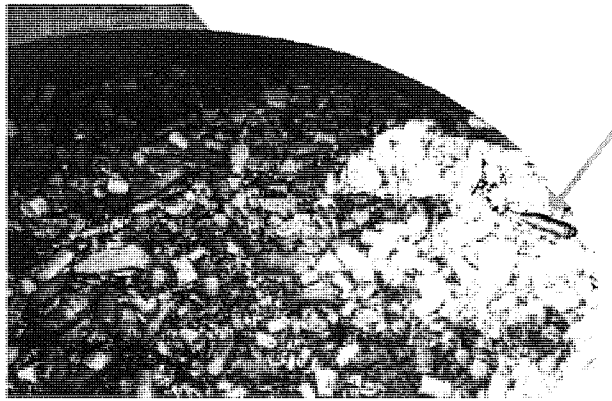


Test results from a vendors website proves that these systems are a source of nutrient pollution.

A stormwater BMP being a source of pollution doesn't make sense.



All pollutants captured in these systems are allowed to float in the standing water. This allows organics to leach their nutrients into the water and allows litter to decompose in the water. This leads to increased levels of nutrients, septic conditions and overall decreased water quality.



CDS/BAFFLE BOX REPORT COMPARISON

	TSS			TOTAL PHOSPHORUS			BOD			Fecal Coliform		
	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT CFU /100 mls	EFFLUENT CFU /100 mls	REMOVAL PERCENTAGE
BAFFLE BOX - SP	81	27	**67%**	1.909	1.022	**46%**	16.391	4.125	**75%**			
BAFFLE BOX - AB	79	28	**65%**	0.29	0.19	**34%**						
BAFFLE BOX - HL	918	126	**86%**	0.47	0.32	**32%**						
BAFFLE BOX - IA	32.9	7.6	**77%**	**1.49**	**0.44**	**70%**	1.88	1.4	**26%**			
CDS - FILMORE	43	58	**-35%**	0.23	0.227	**1%**				8017	34178	**-326%**
CDS - WA	44	49	**-11%**	0.136	0.133	**2%**						
CDS - FL	566	616	**-9%**	1.009	0.889	**12%**	13.095	11.011	**16%**			

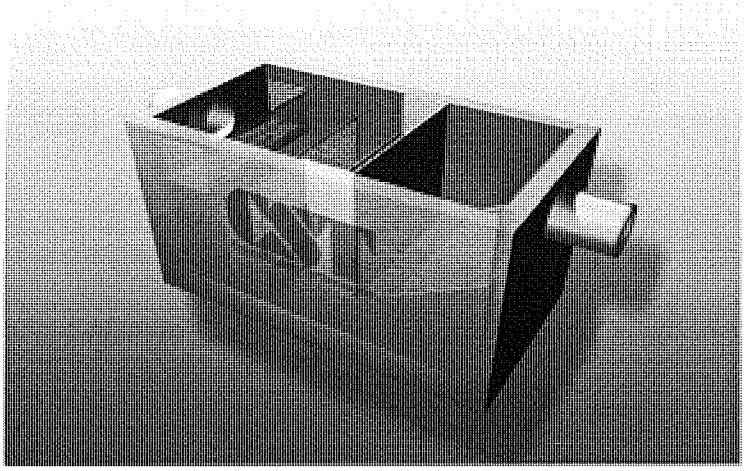
	TOTAL NITROGEN			ZINC			LEAD			COPPER		
	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE	INFLUENT mg/L	EFFLUENT mg/L	REMOVAL PERCENTAGE
BAFFLE BOX - AB	2.46	1.19	**52%**	0.0723	0.041	**43%**	0.0097	0.00593	**39%**	0.0143	0.01013	**29%**
CDS - FILMORE	2.56	2.788	**-9%**	0.268	0.27	**-1%**	0.0104	0.0106	**-2%**	0.025	0.025	**0%**

BAFFLE BOX - SP http://www.bmpdatabase.org/pdfs/427295998d.pdf
BAFFLE BOX - AB http://www.biocleanenvironmental.net/reports/BB/2005_Feb_Blue_Water.pdf
BAFFLE BOX - HL http://www.biocleanenvironmental.net/reports/BB/2004_April_Harveys_Lake.pdf
BAFFLE BOX - IA Call Bio Clean for a copy. This report will be posted on the website by Jan 1st, 2007.

CDS - FILMORE http://www.bmpdatabase.org/pdfs/%2D959760090d.pdf
CDS - WA http://www.bmpdatabase.org/pdfs/272664744d.pdf
CDS - FL http://www.bmpdatabase.org/pdfs/1780773470d.pdf

HYDRODYNAMIC SEPARATION & POLLUTANT SCREENING

CLEAR SOLUTIONS



SITE SPECIFIC ENGINEERING

INTEGRATED INSTALLATION

MAINTENANCE & CLEANING SERVICES

wa·ter qual·i·ty de·vice \wâ-tèr, Kwă-li-tE, di-vIs\ *noun:*

1. Innovative technology, possesing pollution removal capabilities related to stormwater flows. *2.* Relating to a manufactured vault requiring maintenance and inspection on a regular basis and supported by a company willing to provide customer service.

SEE ALSO — CRYSTALSTREAM TECHNOLOGIES

CrystalStream Technologies

COMPANY PHILOSOPHY

"The fact that our product has been tested and proven to remove 89% of pollutants would be completely irrelevant without our total dedication to the "design-installation-cleaning" life cycle for these vaults and a long term commitment to the customer."

John Moll, CEO CrystalStream Technologies

—Site specific design—

The engineers at CrystalStream Technologies work hard to provide water quality solutions that are tailored to the goals of the individual site.

Every site is unique and demands the experience, innovation and dedication to post-construction success that only can be provided by a company that will follow-through with a cleaning plan.

—Integrated Installation—

Time is money on a job site and the operations group at CrystalStream Technologies will coordinate delivery, provide crane services, and follow through to insure customer satisfaction. Every quote includes freight, crane and there are no parts to assemble or additional charges.

A CrystalStream representative attends all installations to provide information and support to the field professionals.

—Cleaning/Maintenance Services—

When we talk about cleaning and maintenance services, it is based on years of experience in the business of cleaning water quality devices and thousands of successful operations.

Consistent, affordable and reliable cleaning is the number one concern for the surface water quality industry and no one can compete with CrystalStream in experience and service.

At CrystalStream, our customer service based approach requires that we meet the needs of all Water Quality Stakeholders including:

ENGINEERS

Innovative Solutions to save Owners Money

Quick Design Turn Around

3 view CAD with inverts

No Substitutes without the Engineer's approval

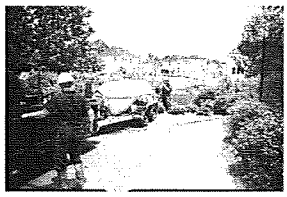
CONTRACTORS

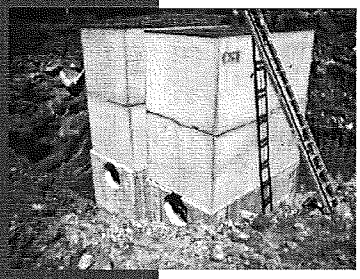
Full Service Delivery including Freight & Crane

Representative on site during Installation

On-Site under 1 Hour

Lower Pricing and Overall cost





OWNERS

Full Service from Design to On-Going Cleaning

Installation Support

Inspection Reporting

Verified Water Quality Results

MUNICIPAL

Tested & Verified

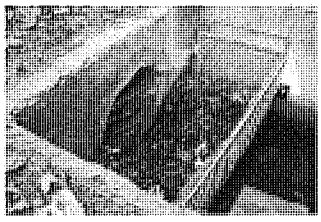
Post-Installation Availability

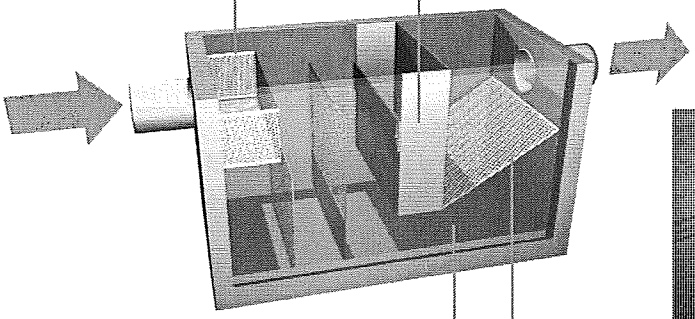
Cleaning/Maintenance Crews Available

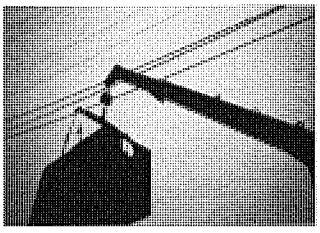
We always design to your local rules and standards

Trash, Vegetative Debris and other large pollutants are screened from the flows using the trash basket. This material is held above the water line to prevent the decomposition that will occur in devices that promote a "floating" strategy. CrystalStream does not believe that these pollutants can be effectively captured and stored by floatation.

Spill Protection is provided using the hydrocarbon reservoir to segregate floating material from the flow pattern. From refueling operations to DOT projects, the ability to prevent a downstream incident resulting from a accidental spill is a clear advantage of the CrystalStream device.







Sediment and associated pollutants are retained by establishing the "Optimal Treatment Flow" based on pollutant type and transportation, cleaning frequency, maintenance and device size. CrystalStream is dedicated to using site specific data to maximize the removal rates for targeted pollutants.

Fiber Filter Media is used to remove neutrally buoyant particles including pre-decomposed nitrogen and phosphorus. Where excess nutrients are the pollutants of concern, this treatment phase set CrystalStream apart from the standard Hydrodynamic device.

APPLICATIONS

STAND ALONE TREATMENT

Ultra-Urban or Downtown Sites

Space Constrained Sites

Spill Protection

Retro-Fit

Sites not requiring detention or with centralized detention

TREATMENT TRAIN or PRE-TREATMENT

Upstream locations to enhance water quality in combination with "fine" treatment system

Upstream locations to reduce the cost of long term cleaning of ponds, sand filters or underground detention systems.

Above natural intermittent streams or man-made swales to eliminate trash

POLLUTANT/INDUSTRY SPECIFIC TARGETING

Industrial

Municipal

DOT's

CSO's

Maintenance Yards

Plant Wash-down

Car Washes

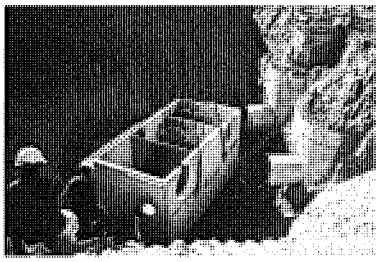
TESTING & PERFORMANCE

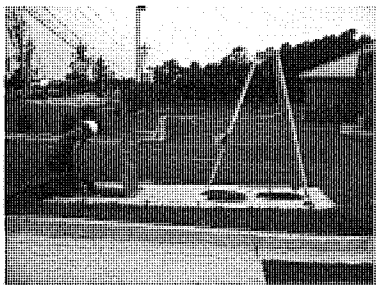
CrystalStream Technologies is committed to both field and laboratory testing of all of its products and services. This includes independent third party testing such as the EPA's ETV program as well as testing in situ by the USGS. Our design process includes in-house and external lab testing on specific flows and pollutants. These methods are valuable tools and provide much needed data but they do not address the individual nature of each site, and the unpredictability of storm water flows. We have found that our field experience including over 4,000 inspections and cleanings provides the broadest and most comprehensive look at the performance of this type of equipment.

The physical data including weights, particle sizes, pollutant typing that has been accumulated over the course of cleaning and maintaining a variety of storm water removal systems had been coupled with our on-going testing program. This allows CrystalStream Technologies to provide customers with information found nowhere else in the world.

Please contact our engineering group to find out about test results and other industry leading information.

Our engineers have completed literally thousands of designs. Professionals have submitted detailed plans of their sites, and we have developed numerous innovative pipe and layout arrangement to meet even the most unique and demanding site conditions. Our extensive design knowledge base comes from working hand in hand with the best design firms in the country. We acknowledge the contributions of the design community to our engineering portfolio, and are always eager to bring the benefits of this pooled expertise to your next project.





GENERAL DESIGN CRITERIA

Model Number	Maximum Design CFS	Water Quality CFS	Spill Protection Gallons	Unit Dimensions
646	6.0	1.8	280	6 x 4 x 6
956	12.5	3.8	550	9 x 5 x 6
1056	17.5	5.3	600	10 x 5 x 6
1266	24.0	7.2	1000	12 x 6 x 6
1246[2]	12.0	3.6	700	12 x 4 x 6
1856[2]	20.0	6.0	1300	18 x 5 x 6
2056[2]	25.0	7.5	1400	20 x 5 x 6
2466[2]	36.0	10.8	2000	24 x 6 x 6
INTERNAL BYPASS UNITS				
1246-B[2]	18.0	3.6	280	12 x 4 x 6
2056-B[2]	35.0	7.5	400	20 x 5 x 6
2466-B[2]	50.0	5.3	600	24x 5 x 6

Higher flows can be treated, please call engineering for information

* All units are sized and internal components placed on a site by site basis depending on multiple factors associated with the specific basin. Maximum flow will seldom vary. Water Quality flow is highly dependent on site conditions and target pollutants. The above criteria is for macro level evaluation and comparable analysis. The unit is standard with a 2/10 foot fall across the device but can be reduced in certain applications.

* Twin vault units. May be inline or side by side

* Twin vault units. Must be side by side

All units are constructed using 4000psi pre-cast concrete and all aluminum internal components. Lids and access are available in multiple configurations including traffic loading and non-traffic.

CLEAR SOLUTIONS

CrystalStream Technologies

WWW.CRYSTALSTREAM.COM

CORPORATE OFFICE

TOLL FREE 800.748.6945
PHONE 770.979.6516
FACSIMILIE 770.979.6954

2080 SUGARLOAF PKWY STE. 230
LAWRENCEVILLE, GA. 30045

All information contained herein is the property of CrystalStream™ Technologies and the product is protected by US and International Patent laws. This information can be changed or updated at anytime at the discretion of CrystalStream Technologies without notice. Graphic Design by Greg Weir.

Environmental Technology Verification (Summary) Report

Stormwater Source Area Treatment Device
CrystalStream Model 1056
Griffin, Ga.
http://www.epa.gov/etv/verifications/vcenter9-9.html

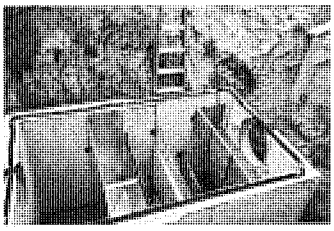
CrystalStream Technologies

REMOVAL RESULTS	
89%	SUSPENDED SEDIMENTS
98%	SAND SIZE PARTICLES
40%	PHOSPHORUS
50%	NITRITES
25%	NITRATES
13%	TKN

The following data and evaluation has been taken from the Verification Report and Joint Verification Statement published by the Environmental Protection Agency (EPA) and NSF International, operator of the Water Quality Protection Center (WQPC). These results are posted on the EPA's website at the above URL.

Independent third party testing was performed on a CrystalStream Model 1056 Water Quality Vault treating approximately 4 acres including a highway, other roadways and parking areas in Griffin, Georgia known as the TEA-21 Project Area. Testing consisted of 15 qualifying events recording flow data and collecting samples using automated composite sampling. These samples were evaluated by Event Mean Concentration (EMC) and Sum of Loads (SOL) analysis. All testing was subject to QA/QC audits as well as an audit of the overall management plan.

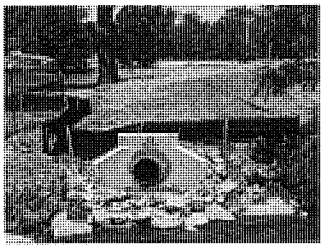
The CrystalStream device for this project is engineered to target the most common pollutants found in urban runoff including trash and debris, sediment, oil and hydrocarbons, and vegetative materials that contribute to over-nutrification. This device was sized to meet the hydrology provided for the site and to provide removal rates meeting the local and federal guidelines for urban runoff. The engineering staff at CrystalStream will answer any questions you have related to the design and application of this technology.



The table below summarizes the removal rates for the pollutants evaluated in this study. The removal rates are based on the sum of loads calculations and the preferred SSC testing method to determine suspended sediment removal over the entire range of particle sizes. The results track with the suspended sediment removal estimates produced in CrystalStream's engineering department which are based on the particle size distribution and flow rates for this site.

Event No.	Date	Runoff Vol.	SSC Inlet	SSC Outlet	Phospho-rus Inlet	Phospho-rus Outlet	Nitrate Inlet	Nitrate Outlet	Nitrite Inlet	Nitrite Outlet	TKN Inlet	TKN Outlet
1	3/26/03	13,800	16	22	0.00	0.02	0.056	0.075	0.002	0.002	0.127	0.138
2	5/5/03	32,900	1,215	28	0.16	0.04	0.055	0.027	NA	NA	0.357	0.384
3	1/25/04	2,890	NA	NA	0.01	0.00	0.007	0.013	0.000	0.000	0.031	0.029
4	4/13/04	20,240	26	20	0.05	0.04	0.061	0.061	0.003	0.001	0.405	0.337
5	4/26/04	10,600	21	12	0.02	0.02	0.019	0.017	0.002	0.002	0.124	0.141
6	4/30/04	16,600	21	13	0.01	0.02	NA	NA	NA	NA	0.083	0.069
7	6/25/04	4,265	5	4	0.01	0.01	NA	NA	NA	NA	0.082	0.046
8	6/28/04	9,730	17	4	0.01	0.01	0.028	0.017	ND	ND	0.097	0.089
9	6/30/04	44,800	14	13	0.12	0.09	0.034	0.026	ND	ND	0.373	0.336
10	7/12/04	9,040	17	6	0.02	0.01	0.024	0.020	0.002	0.000	0.106	0.098
11	7/17/04	9,700	9	6	0.02	0.01	0.053	0.035	0.002	0.000	0.121	0.121
12	7/25/04	22,400	33	10	0.04	0.02	0.067	0.047	ND	ND	0.373	0.261
13	8/5/04	15,400	150	4	0.03	0.01	0.078	0.042	0.003	0.001	0.270	0.154
14	8/12/04	17,100	46	11	0.02	0.02	0.050	0.026	ND	ND	0.086	0.086
15	8/21/04	5,870	12	3	0.01	0.01	0.020	0.012	0.001	0.001	0.069	0.049
Total			1,602	157	0.52	0.32	0.55	0.42	0.016	0.008	2.703	2.340
Removal Rate				89%		40%		25%		50%		13%

Note: Samples were split and the total suspended sediments were measured by both the TSS test method and the SSC test method. Both methods attempt to measure the suspended solids in mg/L, to determine the sediment removal rates for the device. The SCC method was determined to be the most representative for measuring Total Suspended Sediments (TSS), per the preliminary report (Quoting verbatim): "The data show that laboratory precision was generally maintained throughout the course of the verification program with the exception of one nitrate sample and TSS samples. The TSS data showed lower precision, with some of the precision data outside the RPD limits established in the test plan. For many TSS samples, the data were skewed by low and not detected concentrations.



The significance of an 89% removal efficiency for the entire range of sediments and the supporting flow data underscore the strength of the CrystalStream Strategy of on-line treatment. Larger intensities resulting from higher flows carry the bulk of the pollutant load and performance over the entire range of storms is critical to success in gross pollutants removal. The small storms with low intensities carry small amounts of pollutants that are not targeted by water quality vault systems. In addition, the unit was cleaned on a regular basis as is required by federal and state ordinance to assure effectiveness. CrystalStream Technologies is committed to external and internal testing on an ongoing basis with an emphasis on proper application and site specific engineering.

PERFORMANCE TESTING

CONTACT: 2090 Sugarloaf Parkway Ste. 135 Lawrenceville, Ga. 30045 800-748-6945 770-979-6954(fax)

Katchall "Kleerstream"™ Antimicrobial Filtration Chamber

General Specifications / Pricing / Availability – November 2007

Notes:
Bio-Ramps™ (Antimicrobial Filtration Media on Fiberglass Reinforced Frame)
If units are to be installed in vehicle roadways, they require a minimum 1-foot of cover to insure an H20 load rating

- **Model # 120**
  - Footprint - 4.5' W x 6.5' L — 35 S/F
  - @ 4-Foot Vault Depth — 117 Cubic Feet or 4.3 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - Solid Waste Capacity — 1.7 Cubic Yards
  - Two (2) Concrete Baffles
  - One (1) Bio-Ramp — 18 s/f of filtration media
  - Filtration (maximum) — 3,420 GPM or 7.6 CFS
  - Retail (singular) @ $13,500 — FOB – Fontana, CA.
- **Model # 200**
  - Footprint - 4.5' W x 6.5' L — 35 S/F
  - @ 6-Foot Vault Depth — 176 Cubic Feet or 6.5 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - Solid Waste Capacity — 2.6 Cubic Yards
  - Two (2) Concrete Baffles
  - One (1) Bio-Ramp — 27 s/f of media
  - Filtration (maximum) — 5,130 GPM or 11.4 CFS
  - Retail (singular) @ $15,500 — FOB – Fontana, CA.
- **Model # 400**
  - Footprint - 7' W x 14' L — 98 S/F
  - @ 4-Foot Vault Depth — 392 Cubic Feet or 14.5 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - Solid Waste Capacity — 5.8 Cubic Yards
  - Two (2) Concrete Baffles
  - One (1) Bio-Ramp — 56 s/f of media
  - Filtration (maximum) — 10,640 GPM or 23.7 CFS
  - Retail (singular) @ $25,650 — FOB – Fontana, CA.

Katchall "Kleerstream"™ Antimicrobial Filtration Chamber

General Specifications / Pricing / Availability – November 2007

Notes:
Bio-Ramps™ (Antimicrobial Filtration Media on Fiberglass Reinforced Frame)
If units are to be installed in vehicle roadways, they require a minimum 1-foot of cover to insure an H20 load rating

- **Model # 600**
  - Footprint - 7' W x 14' L — 98 S/F
  - @ 6-Foot Vault Depth — 588 Cubic Feet or 22 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - Solid Waste Capacity — 8.7 Cubic Yards
  - Two (2) Concrete Baffles
  - Two (2) Bio-Ramps — 84 s/f of media
  - Filtration (maximum) — 15,960 GPM or 35.6 CFS
  - Retail (singular) @ $29,650 — FOB – Fontana, CA.

- **Model # 700**
  - Footprint - 8' W x 20' L — 160 S/F
  - @ 4-Foot Vault Depth — 640 Cubic Feet or 24 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - One (1) 6' x 8' Spring Assisted Door
  - Solid Waste Capacity — 9.5 Cubic Yards
  - Two (2) Concrete Baffles
  - Three (3) Bio-Ramps — 96 s/f of media
  - Filtration (maximum) — 18,240 GPM or 40.6 CFS
  - Retail (singular) @ $33,500 — FOB – Fontana, CA.

- **Model # 1000**
  - Footprint - 8' W x 20' L — 160 S/F
  - @ 6-Foot Vault Depth — 960 Cubic Feet or 36 Cubic Yards
  - Features one (1) 30-inch Manhole Access Point
  - One (1) 6' x 8' Spring Assisted Door
  - Solid Waste Capacity — 14.2 Cubic Yards
  - Two (2) Concrete Baffles
  - Three (3) Bio-Ramps — 144 s/f of media
  - Filtration (maximum) — 27,360 GPM or 60.1 CFS
  - Retail (singular) @ $37,500 — FOB – Fontana, CA.

Katchall "Kleerstream"™ Antimicrobial Filtration Chamber

General Specifications / Pricing / Availability – November 2007

Notes:
Bio-Ramps™ (Antimicrobial Filtration Media on Fiberglass Reinforced Frame)
If units are to be installed in vehicle roadways, they require a minimum 1-foot of cover to insure an H20 load rating

- **Model # 2000**
  - Footprint - 8' W x 40' L x 6' D — 1,920 Cubic Feet or 71 Cubic Yards
  - Features two (2) 30-inch Manhole Access Points
  - Two (2) 6' x 8' Spring Assisted Doors
  - Solid Waste Capacity — 28.4 Cubic Yards
  - Two (2) Concrete Baffles
  - Six (6) Bio-Ramps — 288 s/f of media
  - Filtration (maximum) — 54,720 GPM or 121.9 CFS
  - Retail (singular) @ $80,625 — FOB – Fontana, CA.

STANDARD POLLUTANT REMOVAL EFFICIENCIES (all units)

Silt (TSS)	>95%	25-micron> size particles
Hydrocarbons	>95%	Absorption & Retention 20X media's molecular weight (1 s/f of media absorbs and retains (appx) .25 Gallons)
Pathogens	99.99%	Instant Kill (with less than 1-second contact time)
Heavy Metals	>55%	Soluble and non-soluble

Nutrients

Ammonia – Nitrogen	>75%
Inorganic Nitrogen	N/D levels
Nitrates as N	N/D levels
Ortho Phosphates / Phosphorus	>55%
Total Phosphorus	>75%

Herbicides	>55%
Pesticides	>55%

CURRENT LEAD TIMES

Lead Times (depending on total quantities ordered) are running between 6 – 8 weeks from the date Katchall receives a signed contract and materials security deposit(s).

PLACEMENT

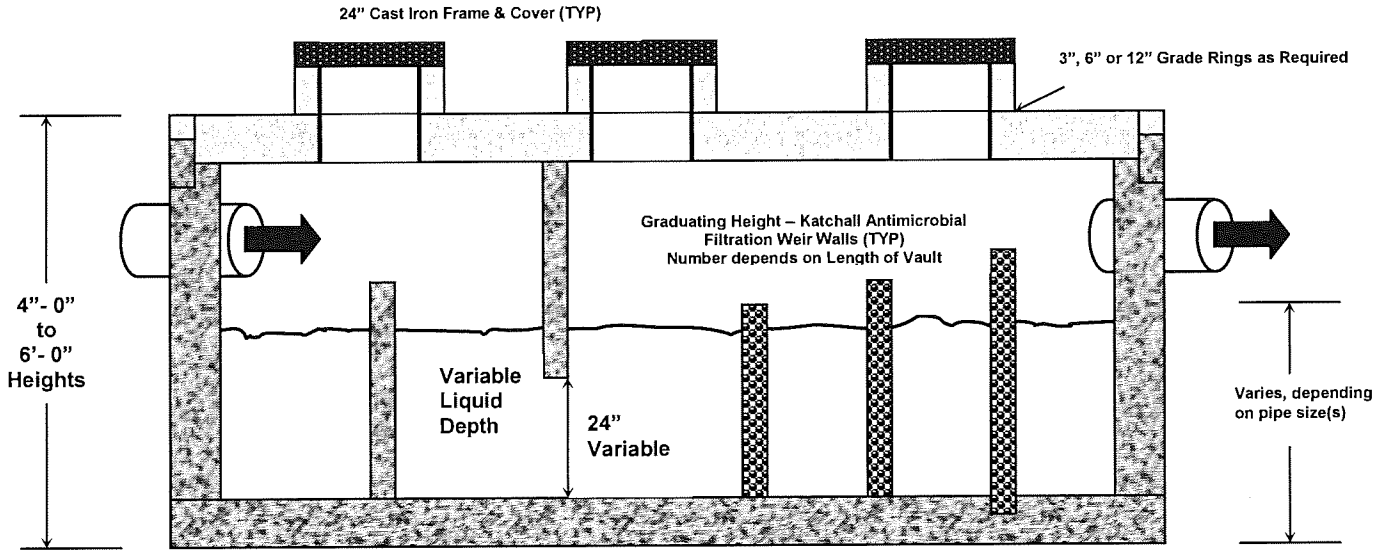
Units can be used either as in-line systems or as off-line systems.

Kleerstream™ by Katchall Filtration Systems, LLC
1 – 866 – KATCHALL www.katchall.net

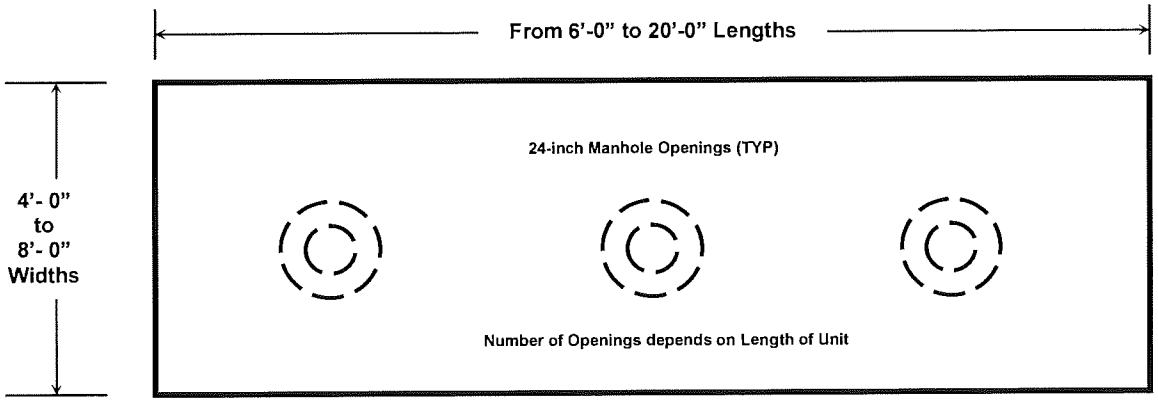
Design Load: H-20 Traffic from 1-foot to 6-foot of cover

(All flow-rates presented below vary from 24-inch pipes to 36-inch pipes @ not less than 12-inch fall per 100 L/F)

Jensen Precast – Fontana, CA, manufactures all Vaults, Grade Rings and Baffles for Katchall



SECTION VIEW



TOP VIEW

MODEL NO.	Dimensions	Footprint Required	(CFS)	GPS	GPM
Model # 120	4'-6" (w) x 6'-6" (l) x 4'-0" (d)	35 Square Feet	7.6 CFS	57 GPS	3,410 GPM
Model # 200	4'-6" (w) x 6'-6" (l) x 4'-0" (d)	35 Square Feet	11.4 CFS	85 GPS	5,116 GPM
Model # 400	7'-0" (w) x 14'-0" (l) x 4'-0" (d)	98 Square Feet	23.7 CFS	177 GPS	10,637 GPM
Model # 600	7'-0" (w) x 14'-0" (l) x 6'-0" (d)	98 Square Feet	35.6 CFS	266 GPS	15,977 GPM
Model # 700	8'-0" (w) x 20'-0" (l) x 4'-0" (d)	160 Square Feet	40.6 CFS	304 GPS	18,221 GPM
Model # 1000	8'-0" (w) x 20'-0" (l) x 6'-0" (d)	160 Square Feet	60.1 CFS	450 GPS	26,973 GPM
Model # 2000	8'-0" (w) x 40'-0" (l) x 6'-0" (d)	320 Square Feet	67.9 CFS	450 GPS	30,500 GPM

Microbac Laboratories, Inc.
Corona Division
280 N Smith Street
Corona CA, 92880

Phone: 1-951-734-9600
http://www.microbac.com

Fax: 1-734-374-2803
e-mail: corona@microbac.com

Microbac

STUDY OF MICROBIOLOGICAL REDUCTION OF WATER WHEN PASSED THROUGH KATCHALL BRAND FILTERING MEDIA

Work Order Number: 0709-363

Date Performed: September 20, 2007

Performed For: Katchall Filtration Systems LLC
475 East 13th Street
Beaumont, CA

Report Reviewed By:

Christopher P. Solan
Managing Director

TABLE OF CONTENTS

INTRODUCTION

The purpose of this test is to evaluate the effectiveness of the Katchall product in a real-time filtration study.

METHODS AND MATERIALS

SOLUTIONS and EQUIPMENT

Inoculate: Approximately 100,000 cfu/ml E. Coli in buffered DI water.
Oil Solution: A mixture of about 40% 10W 30 motor oil, 40% Mineral Oil, and 20% Vegetable Oil
Celite: A dry powdery substance used to mimic silt and find sand.
Pipe: an 18 inch long X 3 inch diameter piece of galvanized pipe.
Katchall Product: The Katchall Product was cut into 6 X 6 inch squares

PROCEDURE:

Test Procedure Performed at Microbac Labs in Corona, CA

A 150 ml sample was poured into a vertically suspended piece of pipe. The Katchall Product was secured to the pipe with an adjustable hose clamp. The filtrate from the Katchall Product was collected in sterile whirl pack bags. The sample was taken immediately into the Microbiological Lab for immediate analysis. The Tests were conducted as follows:

TEST A - BACTERIAN ONLY - (ONE LAYER OF KATCHALL PRODUCT)
TEST B - BACTERIAN ONLY - (TWO LAYERS OF KATCHALL PRODUCT)
TEST C - BACTERIAN ONLY - (THREE LAYERS OF KATCHALL PRODUCT)
TEST D - BACTERIAN ONLY - (FOUR LAYERS OF KATCHALL PRODUCT)
TEST F - BACTERIAN ONLY - (FIVE LAYERS OF KATCHALL PRODUCT)
TEST F - BACTERIAN ONLY - (SIX LAYERS OF KATCHALL PRODUCT)
TEST G - BACTERIA AND 2% OIL - (ONE LAYER OF KATCHALL PRODUCT)
TEST H - BACTERIA AND 2% OIL - (TWO LAYERS OF KATCHALL PRODUCT)
TEST I - BACTERIA AND 2% OIL - (THREE LAYERS OF KATCHALL PRODUCT)
TEST J - BACTERIA AND 2% OIL - (FOUR LAYERS OF KATCHALL PRODUCT)
TEST K - BACTERIA AND 2% OIL - (FIVE LAYERS OF KATCHALL PRODUCT)
TEST L - BACTERIA AND 2% OIL - (SIX LAYERS OF KATCHALL PRODUCT)
TEST M - BACTERIA, 2% OIL & 2% CELITE (SILT) - (ONE LAYER OF KATCHALL PRODUCT)
TEST N - BACTERIA, 2% OIL & 2% CELITE (SILT) - (TWO LAYERS OF KATCHALL PRODUCT)
TEST O - BACTERIA, 2% OIL & 2% CELITE (SILT) - (THREE LAYERS OF KATCHALL PRODUCT)
TEST P - BACTERIA, 2% OIL & 2% CELITE (SILT) - (FOUR LAYERS OF KATCHALL PRODUCT)
TEST Q - BACTERIA, 2% OIL & 2% CELITE (SILT) - (FIVE LAYERS OF KATCHALL PRODUCT)
TEST R - BACTERIA, 2% OIL & 2% CELITE (SILT) - (SIX LAYERS OF KATCHALL PRODUCT)
INOCULUM - BACTERIA ONLY - CONTROL
INOCULUM - BACTERIA AND 2% OIL - CONTROL
INOCULUM - BACTERIA, 2% OIL & 2% CELITE (SILT) - CONTROL
BLANK - CONTROL
MEDIA - CONTROL

OBSERVATIONS AND RESULTS:

The inoculate filtered rather easy through the Katchall Product. The total contact time through a single layer was no more than 10 second for 150 mls to pass through *. As the layers built up, the filtration time also increased.

The oil did slow down the filtration, but the Katchall Product absorbed the oil and also allowed water to filter through it. No oil was visible in the finial filtrate.

The mixture of oil and celite slowed the filtration down further. The Katchall Product still filtered the water through. No oil or celite was visible in the finial filtrate.

The results are listed on the Certificate of Analysis.

CONCLUSION

The Katchall Product eliminated 99.9% of the bacteria load in each 150 ml sample that was passed through it.

CLARIFICATIONS (added September 28th, 2007)

* Contact – pass through times included drip and collection time, actual contact between contaminants and water was about 1 – 2 seconds for all test.

Celite (SILT) is approximately 25-microns in size.

Summary Results of Laboratory Tests Done on Collected Stormwater Samples - Katchall

NOTE: Reference Point – Bacterial Contamination – TMDLs

Santa Ana RWQCB recently established a goal for bacterial TMDLs in stormwater runoffs, via Resolution 99-10, Chapter 5 (Implementation Plan, Discussion of Newport Bay Watershed, pages 5-39 et seq.). Orange County Co-Permitees were given until December 30th, 2013 to meet these new standards.

The intent of these new TMDL standards is to reduce or eliminate any harmful effects from bacterial contaminations present in stormwater discharges, so that they "Do not directly affect designated beneficial uses, specifically, water-contact recreation (**REC-1**) and shellfish harvesting (**SHEL**)".

The new TMDL standards are: "5-Sample/30-days Geometric Mean less than 200 organisms / 100 mL and not more than 10% of the samples to exceed 400 organisms /100 ml for any 30-day period".

Katchall (since 2005) has consistently exceeded the new goals set for 2013 TMDL implementation, in areas where nether (**REC-1**) or (**SHEL**) conditions exist. Enclosed is a brief summary of some of the laboratory tests completed to date. *(Bacterial influent levels are approximations only)*

- **Tract# 25981 / Residential Subdivision / Hemet, CA**
  November 25th, 2005

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	650 MPN / mL	1.1 MPN / mL	99.99%
E. coli	350 MPN / mL	1.0 MPN / mL	99.99%
Nitrates	35 MPN / mL	N / D	
PH	7.8	7.0	
TSS	850 mg / L	14 mg / L	99.98%
Nutrients			
Ammonia – Nitrogen	37.4 mg / L	.11 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.98 mg / L	.54 mg / L	55.10%
Total Phosphorus	.65 mg / L	.05 mg / L	76.92%

- **Tract # 28148 / Residential Subdivision / Murrieta, CA**
  December 15th, 2005

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	450 MPN / mL	1.3 MPN / mL	99.99%
E. coli	280 MPN / mL	1.0 MPN / mL	99.99%
Nitrates	25 MPN / mL	N / D	
PH	7.4	7.0	
TSS	950 mg / L	14 mg / L	99.98%
Nutrients			
Ammonia – Nitrogen	34.7 mg / L	.09 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.68 mg / L	.43 mg / L	63.34%
Total Phosphorus	.41 mg / L	.04 mg / L	97.56%

- **Tract # 16247 / <u>Residential Subdivision</u> / Victorville, CA**
  January 16th, 2005

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	390 MPN / mL	1.1 MPN / mL	99.99%
E. coli	290 MPN / mL	.09 MPN / mL	99.99%
Nitrates	27 MPN / mL	N / D	
PH	7.6	7.1	
TSS	935 mg / L	16 mg / L	99.98%
Nutrients			
Ammonia – Nitrogen	36.8 mg / L	.07 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.72 mg / L	.43 mg / L	59.72%
Total Phosphorus	.43 mg / L	.04 mg / L	93.02%

NOTE - Katchall altered the application methodology of the antimicrobial agent during the 2005 Christmas Holiday Season. As opposed to using a spray-on application; we implemented a new (proprietary) application process which allow for greater permeation of all the fibers, as opposed to only penetrating a few of fibers closest to the exterior of the filtration medias "fabric-blanket".

- **Tract # 16992 / <u>Residential Subdivision</u> / Fontana, CA**
  February 10th, 2006

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	550 MPN / mL	1.0 MPN / mL	99.99%
E. coli	390 MPN / mL	1.1 MPN / mL	99.99%
Nitrates	45 MPN / mL	N / D	
PH	7.2	7.0	
TSS	1250 mg / L	45 mg / L	99.98%
Nutrients			
Ammonia – Nitrogen	34.7 mg / L	.07 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.98 mg / L	.37 mg / L	37.75%
Total Phosphorus	.76 mg / L	.05 mg / L	65.78%

- **Tract # 16993 / <u>Residential Subdivision</u> / Fontana, CA**
  March 5th, 2006

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	600 MPN / mL	1.3 MPN / mL	99.99%
E. coli	425 MPN / mL	1.0 MPN / mL	99.99%
Nitrates	38 MPN / mL	N / D	
PH	7.1	7.0	
TSS	1165 mg / L	41 mg / L	97.28%
Nutrients			
Ammonia – Nitrogen	32.5 mg / L	.06 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.78 mg / L	.34 mg / L	43.59%
Total Phosphorus	.45 mg / L	.04 mg / L	88.88%

- **Tract #15697 / <u>Residential Subdivision</u> / Fontana, CA**
  March 6th, 2006

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	650 MPN / mL	1.0 MPN / mL	98.99%
E. coli	425 MPN / mL	1.1 MPN / mL	99.99%
Nitrates	42 MPN / mL	N / D	
PH	7.4	7.0	
TSS	950 mg / L	45 mg / L	99.95%
Nutrients			
Ammonia – Nitrogen	36.5 mg / L	.07 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.78 mg / L	.33 mg / L	42.31%
Total Phosphorus	.46 mg / L	.03 mg / L	65.22%

- **Tract # 16919 / <u>Residential Subdivision</u> / Fontana, CA**
  March 25th, 2006

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	575 MPN / mL	1.0 MPN / mL	98.99%
E. coli	425 MPN / mL	1.1 MPN / mL	99.99%
Nitrates	41 MPN / mL	N / D	
PH	7.2	7.0	
TSS	850 mg / L	45 mg / L	95.98%
Nutrients			
Ammonia – Nitrogen	34.7 mg / L	.07 mg / L	99.98%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.76 mg / L	.37 mg / L	48.68%
Total Phosphorus	.42 mg / L	.05 mg / L	67.52%

- **<u>Industrial Permit</u> / Beaumont, CA**
  January 26th, 2007

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	275 MPN / mL	1.0 MPN / mL	98.99%
E. coli	225 MPN / mL	0.9 MPN / mL	99.97%
Nitrates	21 MPN / mL	N / D	
PH	7.6	7.0	
TSS	2250 mg / L	45 mg / L	98.00%
Nutrients			
Ammonia – Nitrogen	33.2 mg / L	.07 mg / L	99.98%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.68 mg / L	.37 mg / L	54.41%
Total Phosphorus	.39 mg / L	.05 mg / L	87.50%

- **Industrial Permit / Beaumont, CA**
  January 31st, 2007

Pollutant	Influent Levels	Effluent Levels	Removal %
Fecal coliform (by calc)	375 MPN / mL	1.0 MPN / mL	98.99%
E. coli	200 MPN / mL	1.1 MPN / mL	98.94%
Nitrates	410MPN / mL	N / D	
PH	7.5	7.0	
TSS	1650 mg / L	45 mg / L	98.8%
Nutrients			
Ammonia – Nitrogen	33.7 mg / L	.07 mg / L	99.99%
Inorganic Nitrogen	N / D	N / D	
Nitrate as N	N / D	N / D	
Ortho Phosphate / Phosphorus	.74 mg / L	.37 mg / L	50.00%
Total Phosphorus	.41 mg / L	.05 mg / L	89.65%

We wish to take this opportunity to point out that the results of all laboratory tests of collected stormwater samples (subjected to "real-world" discharges) have continued to demonstrate the unique pollutant reduction / removal capabilities of the Katchall products.

CESC Engineering, LLC conducted the water sampling collection and transportation to the laboratories. Pollutant influent levels were ascertained utilizing a Horiba Multi-Sensor Probe.

Antimicrobial Test – September 2007

Katchall Filtration Systems, LLC

Although several manufacturers are offering stormwater filtration devices touted as providing effective treatment against pathogens, (Bacteria) regulatory agencies usually have additional questions pertaining to their long-term effectiveness.

The purpose of the recently completed (September 2007) Katchall Antimicrobial test was to provide additional (third party) laboratory documentation of the long-term efficiency of the Katchall Filtration devices.

- **SOME FREQUENTLY ASKED QUESTIONS**

(1) Does the product really perform as well as advertised?

(2) What flow rates can we reasonably expect your devices to handle?

a. Low-flow events (first-flush) only?
b. Medium to High-flow events?

(3) What contact time is required between the antimicrobial agents and the stormwater?

a. Most laboratory tests have either used stagnant water chambers for time efficacy studies or,
b. The standard ASTM one-hour shaker test (ASTM # EE2149-01) or
c. The standard ACTM 0210 BPS Extraction Method.

(4) How long does the antimicrobial properties continue to function when exposed to repeated storm events?

(5) Hydrocarbons have demonstrated that they will cause fouling of most of these devices, at what point does the Katchall product lose its ability to kill microorganisms when exposed to heavy / repeated concentrations of hydrocarbons?

(6) What are the maintenance / disposal issues?

(7) What are the anticipated annual costs of the Katchall antimicrobial filtration devices as opposed to the other manufacturers?

- **HISTORICAL DOCUMENTATION**

Katchall antimicrobial filtration devices have consistently demonstrated the following characteristics in real-world applications.

- Unobstructed flow rates of 190 GPM, per square foot, of filtration media surface area.
- Filtration to a 50-micron level (diameter of a human hair)
- Hydrocarbon removal / retention efficiencies of 95%, or better.
- Nutrients, nitrates, phosphates, phosphorus removal efficiencies or 65%, or better.
- Heavy metal removal efficiencies of 55%, or better.
- 99.99% INSTANT KILL of single-cell microorganisms.

- **ESTABLISHING NEW LABORATORY TESTING PROTOCOLS**

In order to provide additional (third party) documentation of the effectiveness of the Katchall devices, we contacted the Environmental Protection Agency (EPA) and asked for their recommendations of an EPA certified laboratory that could establish new testing protocols.

We needed to establish new testing protocols that would more effectively demonstrate the INSTANT KILL nature of the Katchall Antimicrobial Filtration products, and not use timed-efficacy studies (stagnant water chambers) or the one-hour ASTM "shaker" test.

What EPA recommended was that we contact Microbac Laboratories (Corona, CA) as they could assist with establishing new testing protocols and perform highly detailed laboratory analysis with actual bacterial plate counts vs. using the Most Probable Number (MPN) method.

- **NEW TESTING PROTOCOLS**

The new testing protocols that Katchall and Microbac Laboratories established were designed to test the effectiveness of the Katchall antimicrobial filtration media with no extended contact times, instead utilizing a "quik-pass" system **which limited the contact times** (contaminated water vs. filtration media) **to less than .25 seconds.**

Approximately 100 6-inch X 6-inch square pieces of the Katchall antimicrobial filtration media were supplied to Microbac Laboratories and the following test procedures utilized.

- A 3-inch round PVC pipe was secured in an upright position with the filtration media secured across the top of the pipe, with the contaminated water poured over the filtration media and discharged into several 4-inch x ½-inch petri dishes.
- **The pipe was cleaned after each test prior to beginning the next test.**
- Whereas most Katchall products contain six (6) individual "layers" of treated media, we established testing based on utilizing one (1) single layer of the filtration media, sanitized the pipe, utilizing two layers of the filtration media, sanitized the pipe, utilized three layers of filtration media, etc.

- **BATCH TEST # 1 – BACTERIAL INNOCULUM ONLY**

As Microbac explained to us, the bacterial concentration is usually about 5,000 cfu/mL, with a concentration of 10,000 cfu/mL considered a "heavy bacterial concentration".

As we wanted to demonstrate the extreme capabilities of the Katchall Antimicrobial Filtration Media, we intentionally increased the bacterial concentration to **50,000 cfu/mL** for all test, **5 times (5X) the normal concentrations used.**

All samples collected (after passing through the Katchall filtration media) were allowed to incubate for a 48-hour period, actual plate counts were done and the results are as follows:

TEST NUMBER	LAYERS USED	CONTACT TIME	RESULTS
# 1	Single (1)	.10 Seconds	100% KILL
# 2	Two (2)	.11 Seconds	100% KILL
# 3	Three (3)	.12 Seconds	100% KILL

- **BATCH TEST # 2 – BACTERIA AND HYDROCARBONS**

As Microbac explained it to us, 1,000 ppm is the maximum concentration of hydrocarbons (oils, greases) allowed in stormwater by EPA.

Again, as we wanted to demonstrate the extreme capabilities of the Katchall Antimicrobial Filtration Media, we intentionally increased the hydrocarbon concentrations to **20,000 ppm for all test, 20 times (20X) the normal concentrations allowed by EPA,** the results are as follows:

TEST NUMBER	LAYERS USED	CONTACT TIME	RESULTS
# 1	Single (1)	.13 Seconds	100% KILL
# 2	Two (2)	.14 Seconds	100% KILL
# 3	Three (3)	.15 Seconds	100% KILL

Additional test were utilized to determine if the hydrocarbon concentrations were not in some way contributing to the kill rate of the bacterial innoculum.

The results of these additional test demonstrated that the heavy hydrocarbon concentrations did not contribute (in any way) to the high kill ratios; the antimicrobial agent was the only source that eradicated the bacteria.

- **BATCH TEST # 3 – BACTERIA, HYDROCARBONS, SEDIMENT**

Even though we had already exceeded the "real-world" conditions of stormwater discharges and their influent concentrations, we decided to push onwards and concocted a mixture for our final round of tests.

Bacteria Concentration Level 50,000 cfu/mL
Hydrocarbon Concentration Level 20,000 ppm
Sediment Concentration Level 250,000 ppm

The results are as follows:

TEST NUMBER	LAYERS USED	CONTACT TIME	RESULTS
# 1	Single (1)	.15 Seconds	100% KILL
# 2	Two (2)	.17 Seconds	100% KILL
# 3	Three (3)	.23 Seconds	100% KILL

- **SUMMATION OF TEST RESULTS**

With an EPA recommended laboratory (Microbac) conducting all tests we received additional confirmation that the Katchall Antimicrobial Filtration Media continues to outperform any other product(s) available.

DEMONSTRATED PERFORMANCE

1. **There is NO need for extended contact times between contaminated water and the filtration media.**

2. **Even at 20 times the EPA maximum hydrocarbon concentration levels there was no reduction in the kill rates.**

3. **Even when the media was partially obstructed with excessive amounts of both hydrocarbons and sediment, there was still NO reduction in the efficiency of the *instant* microorganism kill rates.**

Answers to Those Frequently Asked Questions

Q: Does the product really perform as advertised?

A: With over 4-years of "real-world" applications and the recent laboratory test results we would have to admit that the products actually performed even better than we had originally anticipated.

Q: What flow-rates can we reasonably expect your devices to handle?

A: Unobstructed the filtration media will filter 100% of stormwater discharges at 190 GPM, per square foot; of filtration media surface area, i.e.

EXAMPLE:

A standard Katchall Curb Inlet Filter (3-foot length X 12-inch width) will filter 1.33 CFS or 10 Gallons Per Second (GPS). A 21-foot Curb Inlet will filter 100% of discharges @ 9.31 CFS or 69.6 Gallons Per Second (GPS).

"Real-world installations" have shown that the Katchall filtration devices, (due to their extremely high flow / filtration rates) can maintain 100% filtration of discharges even during 25 to 50-year storm events.

Q: What contact time is required between the antimicrobial agents and the stormwater?

A: According to all available data, even with extremely high concentrations of bacteria, hydrocarbons and sediment, LESS THAN .23 SECONDS to achieve a 100% kill rate.

Q: How long does the antimicrobial properties continue to function when exposed to repeated storm events?

A: Some of our earliest antimicrobial units were installed in 2004 and, without us replacing the filtration media; they are still providing the same level of protection as they did when originally installed.

Q: At what point does the product lose its ability to kill microorganisms when exposed to heavy / repeated concentrations of hydrocarbons?

A: Additional Laboratory tests are being completed to determine exactly what those parameters are, but so far we have not experienced these problems with any of the Katchall products.

Q: What are the maintenance / disposal issues?

A: As we are all well aware of, implementing a routine maintenance schedule plays an extremely crucial role in filtration devices, especially with the Katchall products due to their 50-micron filtration capabilities. Virtually anything can eventually obstruct a filtration device, i.e. sediment, trash, grass clippings, leaves, etc. This is why Katchall offers extended maintenance service contracts to all of its Clients.

Disposal of a Katchall "Bio-Ramp"® is a relatively simple matter BUT is considered to be a Class II hazardous waste product when hydrocarbons are the source of contamination; otherwise it can usually be disposed of in a common waste containment unit, (i.e. your local trash collection company bins).

Q: What is the anticipated annual maintenance costs of the Katchall antimicrobial products as opposed to other manufacturers annual cost?

A: As the filtration media itself does not normally require routine replacements, annual maintenance costs are substanually reduced from those of our competitor's, i.e. Filterra, AbTech Smart Sponge, etc.

- **ADDITIONAL INFORMATION**

The Santa Ana Regional Water Quality Control Board (Region 8) recently adopted the new TMDL (Total Maximum Daily Load) restrictions for the Newport Bay, as a part of Resolution # 99-10.

The requirements (for all contributory dischargers) is that no discharges occur with a bacterial count greater than 400 cfu/100mL.

The SARWQCB has established a deadline of December 30th, 2013 for an effective treatment system(s) to be in-place.

KATCHALL has been providing clients with products that have been EXCEEDING these "new" standards for the past 3-years.

- **SUMMATION**

Now that the tremendous beneficial capabilities of the Katchall products have (once again) been documented, we expect the regulatory agencies to not only acknowledge the benefits of the Katchall Antimicrobial Filtration Products and unilaterally approve the Katchall product line, but also to start insisting upon the use of the Katchall products in both new construction and in retrofit applications.

3.2.4. Subsurface Reservoir Bed

In some cases parking lots can be designed to perform more complex stormwater management functions. Subsurface stormwater storage and/or infiltration can be achieved by constructing a stone-filled reservoir below the pavement surface and directing runoff underground by means of perforated distribution pipes. Subsurface infiltration basins eliminate the possibilities of mud, mosquitoes and safety hazards sometimes perceived to be associated with ephemeral surface drainage. They also can provide for storage of large volumes of runoff, and can be incorporated with roof runoff collection systems. These underground infiltration and storage systems are relatively expensive, and require extensive engineering, but have been used in a variety of locations in the eastern United States where land values are high and the need to control runoff is great [31]. Similar high land values are found throughout the San Diego Area, and as emphasis on stormwater management increases, the economic viability of these solutions will increase.

Based on the infiltration rate of the underlying soils, additional storage may be required in the granular sub-base layer of a porous pavement section. The required storage may be based on a comparison of the rate of infiltration of the sub-soils and the design storm hydrograph. However, sites with low permeability soils (type D) may require underdrains and/or liners to prevent seepage from damaging existing structures or slopes. For further information on infiltration considerations, please see Appendix 3.G "LID Treatment BMPs Design Considerations".

For more information on Recharge Beds please see **Fact Sheet 11** in Appendix 4.

3.2.5. Granular materials

A wide variety of loose aggregates can be made to form permeable pavements suitable for walking, jogging, biking, or light vehicular traffic. The size of these granular materials ranges from fine aggregates to large stones, and can be divided into two general categories: gravels and cobbles. Depending on the aggregate size, these granular pavements have a runoff coefficient of 0.20" to 0.40" [31].

If laid on a slope, and subjected to moderate traffic or concentrated runoff, loose gravel can be displaced and require periodic regrading. Weed abatement may be required periodically, though this can be reduced by laying permeable landscape fabric between the gravel and subgrade. Organic materials such as bark or wood chips decompose over time and must be replenished. Some mulches meet federal requirements for playground fall surfaces and can be inexpensive, permeable pavements for outdoor play areas. Installation costs for gravel and other granular materials are generally the least of all permeable pavements, but require a degree of periodic maintenance to preserve the integrity of the pavement surface.

For more information on Granular Materials please see **Fact Sheet 12** in Appendix 4.

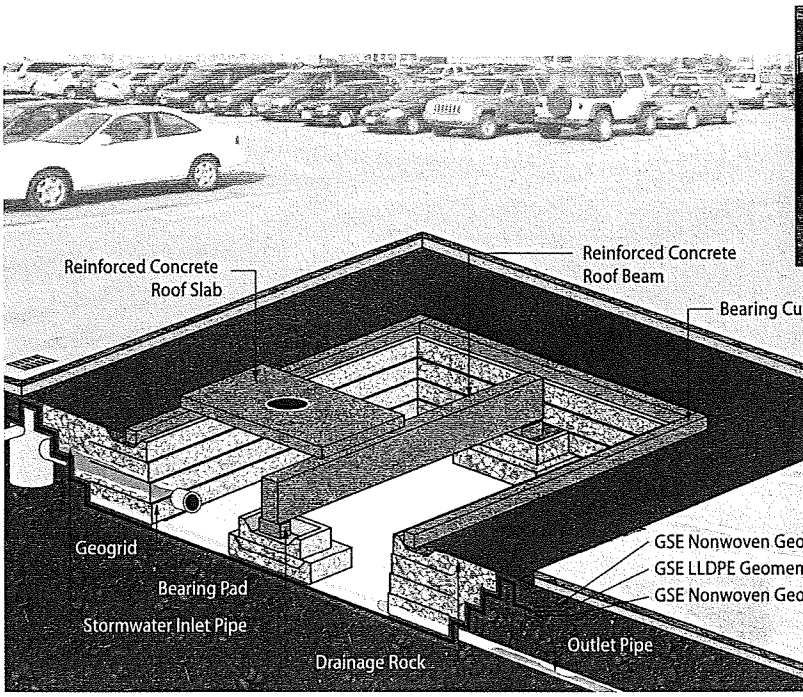
GSE GeoStorage

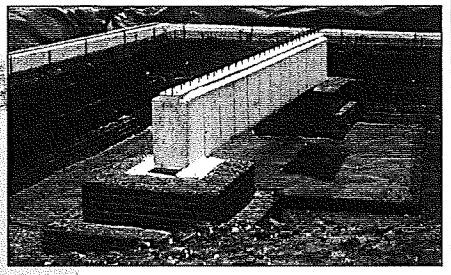
UNDERGROUND STORMWATER DETENTION SYSTEM

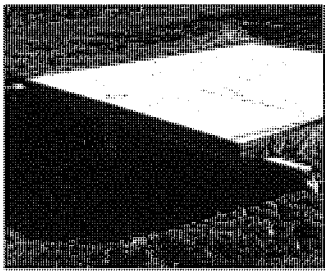
GSE GeoStorage Redefines Stormwater Management

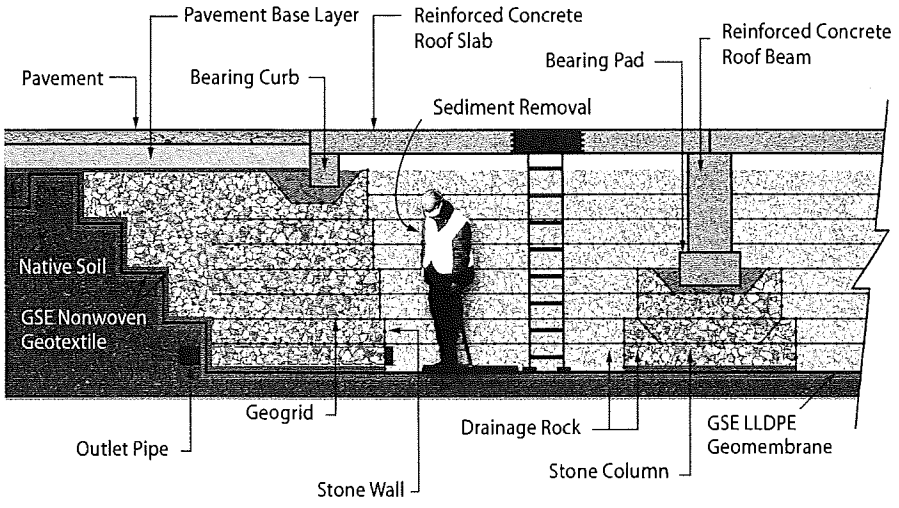
All land development projects require a stormwater management design. A surface holding pond is the most common stormwater detention and retention systems used to capture and control the increase in peak runoff associated with large storm events. GSE GeoStorage is installed beneath parking lots, streets and parks to maximize land usage and lower development costs as shown below. GSE leads the industry in developing innovative installation techniques to customize your design to meet local stormwater regulations.

How GSE GeoStorage Works









GSE Nonwoven Geotextile | GSE LLDPE Geomembrane | GeoGrid

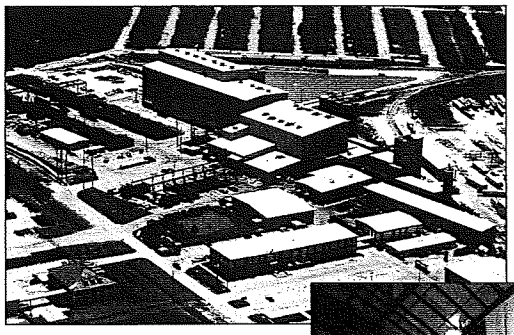
GSE GeoStorage The Next Genera

Introduction

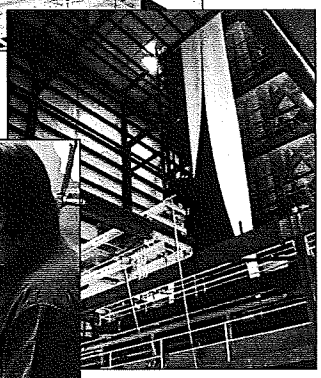
The use of underground stormwater detention systems is rapidly expanding as builders are challenged with escalating development costs and stiffening regulations. GSE Lining Technology, Inc. is leading the way in new technology with GSE GeoStorage, the Next Generation in underground detention and retention systems.

GSE GeoStorage offers land developers cost savings over traditional systems in a significantly smaller footprint. The footprint size, configuration and depth can be customized for each individual site. This unique, patent pending design concept provides a large chamber for easy access and maintenance, an important consideration to owners and public works departments. GSE products are manufactured to perform in the most aggressive environments. For added reliability, GSE GeoStorage is backed by an experienced team of engineering and construction professionals ready to exceed the customer's expectation.

GSE has been a leading, global geosynthetic manufacturer and installer for over 30 years. GSE offers a broad array of geosynthetic products and innovative installation techniques to perform in the environmental and civil markets. GSE has a worldwide network of professionals to make your project a success no matter where your project is located.



GSE Corporate Headquarters, Houston, Texas



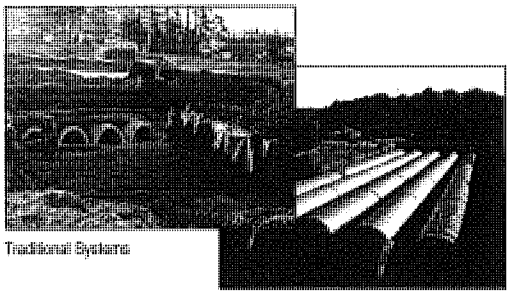
GSE Manufacturing Facility

GSE Engineering Staff at work

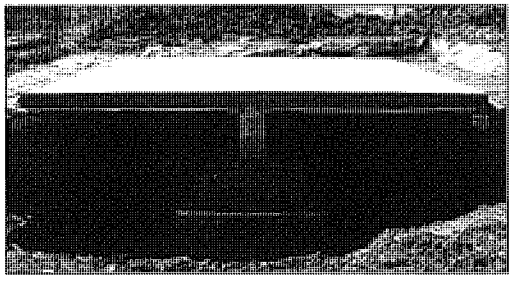
Traditional Systems versus The Next Generation System

Pipes and pipe arches comprise most traditional underground storm water detention systems. Flexible plastic and metal pipes require a compacted structural backfill above, below and around the pipe resulting in additional costs and a large footprint.

GSE GeoStorage, the Next Generation, utilizes AASHTO (American Association of State Highway and Transportation Officials) standards to design a large, deep underground storage chamber. Walls and columns are constructed with open graded stone to eliminate pore pressures and provide additional storage capacity. The efficiency of GSE GeoStorage reduces costs and the size of the excavation. The cost advantage improves on projects with a rock sub-grade or where excess fill must be hauled off-site. In applications such as split level mall parking lots, where passenger vehicle loads can be assumed rather than HS-20 highway loads, the savings can be even more considerable. Where a water tight system is required, GSE has been lining hazardous and municipal waste landfills for 30 years.



Traditional Systems



GSE GeoStorage System

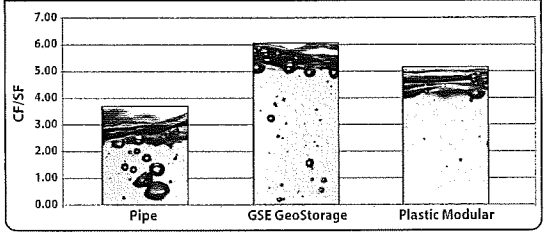
Performance Analysis

GSE GeoStorage not only offers substantial savings when compared to traditional systems, it features inherent properties and benefits that improve overall performance and provide maximum design flexibility.

Project Advantages		
✓	COST	Substantial savings over traditional detention and retention systems.
✓	SIZE	Requires smaller footprint than traditional systems as shown below in land efficiency chart.
✓	DURABILITY	Constructed with a reinforced concrete roof, stone, and geosynthetic products that have been tested to withstand landfill leachate.
✓	STORMWATER QUALITY	Does not increase metal loading in stormwater. A zinc coating sacrifices itself to protect the base metal of traditional galvanized steel pipes.
✓	MAINTENANCE	Large and open chambers allow for easy access and maintenance. It is the only system that allows for the inspection and replacement of a clogged filter fabric in a retention and recharge application.
✓	FLEXIBILITY	Capacity is a function of column placement and height. These parameters can be adjusted to fit the required depth and footprint.
✓	INSTALLATION RATE	Installed faster than traditional systems.
✓	LOAD CAPACITY	Designed for a HS-20 highway loading, passenger vehicle loading or other loading condition as required.

Site Conditions That Increase Advantages	
+	Surface Loads < HS-20
+	Cut Sites-Off Site Hauling Required
+	Tight Sites
+	Rock Excavation
+	Low Leakage Requirements
+	Stormwater Treatment Required

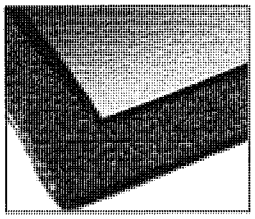
Land Efficiency (100,000 CF)

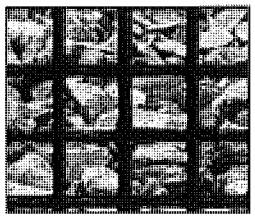


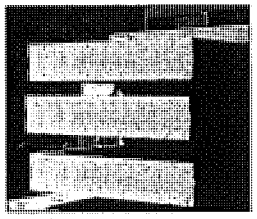
Applications

GSE GeoStorage can be used in:

- *Commercial Property*
- *Residential Property*
- *Industrial Development*
- *Infrastructure*
- *Airports*
- *Schools*
- *Sports Facilities*


Liner


Stonewall


Roof

Leadership in Energy and Environmental Design (LEED)

GSE GeoStorage contributes to satisfying credit achievements of the U.S. Green Building Council's LEED Green Building Rating System™. For example:

1. Reduces truck traffic to the construction site.
2. Reduces the amount of excavation and potential off-site hauling from the construction site.
3. Provides a reusable water supply with a water tight system.

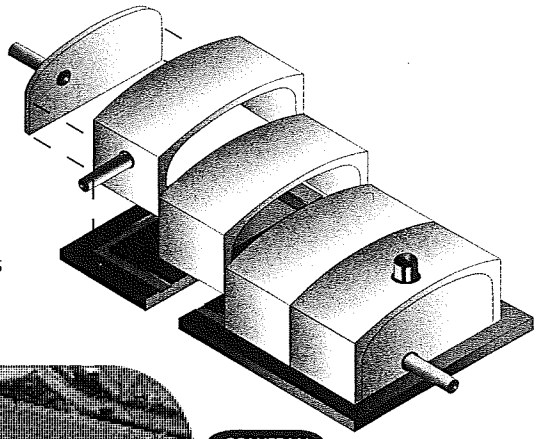
For more information on LEED's rating system please visit www.usgbc.org.

Concrete Detention

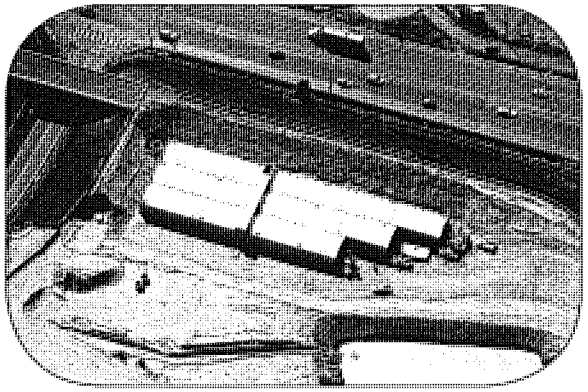
CONTECH Stormwater Solutions concrete detention/retention products offer cost-effective, belowgrade stormwater storage. The modular precast systems offer tremendous versatility in accommodating footprint needs and maximizing available land use.

CON/SPAN®

- Custom designed and manufactured to meet site specific requirements
- Wide range of span and rise combinations available for design flexibility
- Quickly and easily installed
- Off-site fabrication ensures tight adherence to specifications, less on-site work, and quality control of modular units
- Arch shape provides the ability to support high live loads efficiently, which lowers material and detention systems costs
- Comprehensive technical product support eliminates the need for site-specific structural engineering calculations

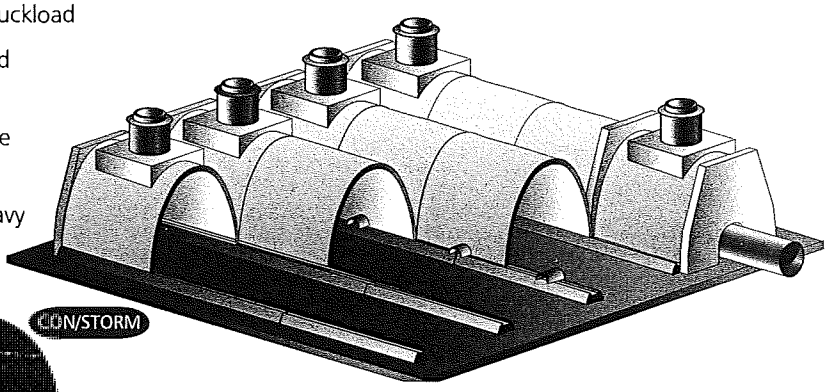


CON/SPAN

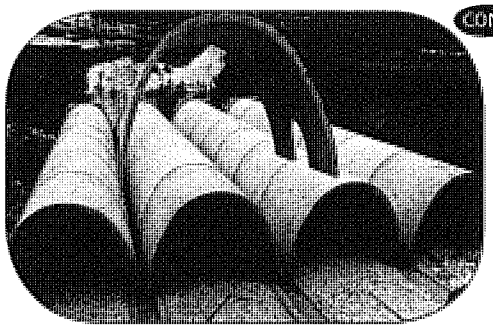


CON/STORM™

- Structurally efficient concrete arch maximizes storage per ton of concrete
- Lightweight units and nesting maximizes storage per truckload
- Thinner concrete section results in efficient shipping and handling of units
- Wide range of span and rise combinations with multiple foundation choices provide design flexibility
- Systems install quickly and easily without the use of heavy construction equipment



CON/STORM

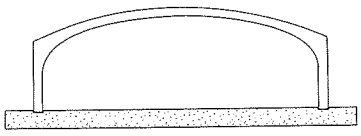


MODULAR CONCRETE DETENTION SYSTEMS

Foundation Versatility

The CON/SPAN and CON/STORM precast elements are three-sided arch units. In order to create a complete system and ensure structural integrity, both systems are installed on top of cast-in-place concrete foundations. These foundations provide continuous support beneath the unit legs and prevent the possibility of any differential settlement between adjacent precast units. Precast elements are set in a keyway that is cast into the foundation. CON/SPAN and CON/STORM systems can be installed on either a full structural base slab or strip foundations. Strip foundations, when utilized, extend around the perimeter of each cell of the vault system. In order to create additional vertical rise the CON/SPAN system can also be installed on top of a pedestal wall foundation. Engineers at CONTECH can assist with providing horizontal and vertical foundation reactions or can perform the complete foundation design upon request.

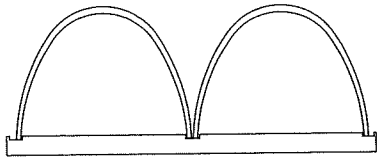
CON/SPAN

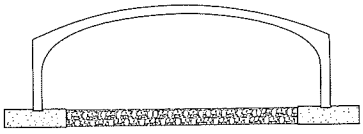


Base Slab Foundation

The base slab is the most common foundation for the CON/SPAN and CON/STORM detention systems. A base slab is the ideal solution when creating a water-tight system. It's also the most practical solution when dealing with high water table issues or sub grade soils sensitive to water infiltration.

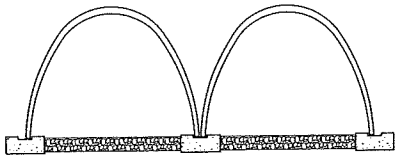
CON/STORM

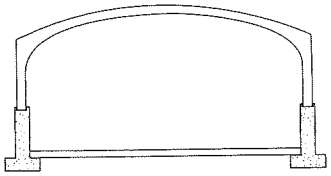




Strip Foundations

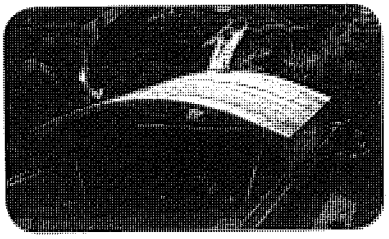
Construction of cast-in-place strip foundations beneath the unit legs and endwalls allows for a large open area in the center of each cell. This open area is typically filled with a crushed stone or granular material. The CON/SPAN or CON/STORM system can then be utilized for infiltration or recharge by percolating runoff through the granular material inside of the foundations.





Pedestal Wall Foundation

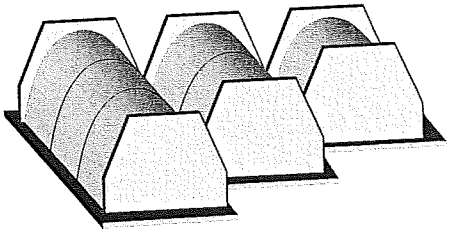
Creating additional vertical rise through the use of a cast-in-place stem wall allows the CON/SPAN system to be designed for the most storage in the smallest possible footprint.



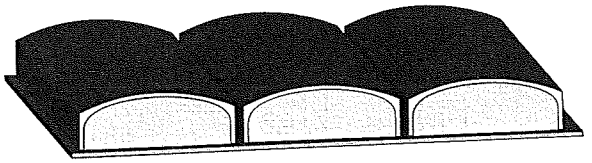
Layout Versatility

The modular nature of the CON/SPAN and CON/STORM system allows for tremendous versatility in layout. The systems can be installed in multiple cells and with staggered ends to accommodate nearly any footprint. Further versatility comes from the ability to create skewed or "pie-shaped" pieces. This provides the ability to construct a vault along a curved alignment to follow a roadway or other challenging location.

Staggered Ends

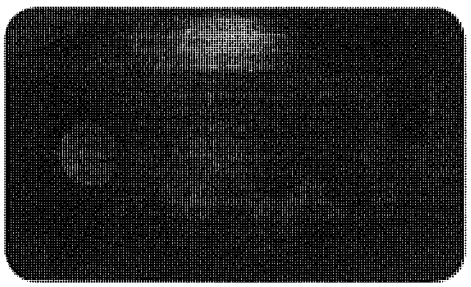


Multiple Cells



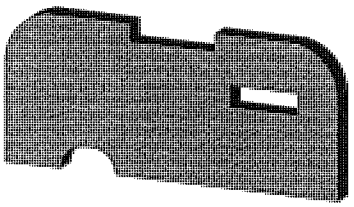
Outlet Control Versatility

All CON/SPAN and CON/STORM detention structures come with precast end walls on all ends to create an enclosed vault. In addition, supplemental precast walls can be placed inside the structure to control flows. Placing a precast wall inside the structure provides the versatility to cast a wide variety of outlet openings into the system. Typical openings include a low-flow circular orifice, rectangular openings, multiple stage weirs, and overflow weirs. The number of openings that can be provided is essentially unlimited allowing for the ability to accommodate a large number of design storms. Using longer weirs in CON/SPAN structures minimizes the head that must be created over the weir to bypass larger flow rates. Integrating these walls into the overall system eliminates the need for downstream outlet controls.

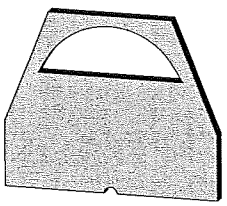


Outlet control weir wall

Variable weirs to accommodate any flow rate and multiple design storms.



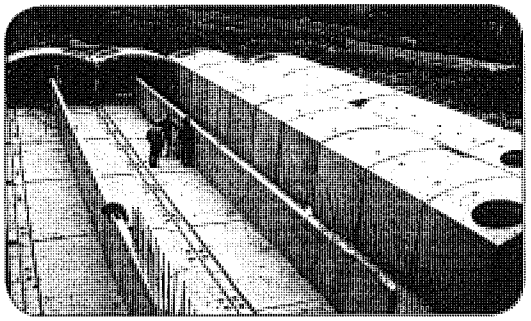
CON/SPAN

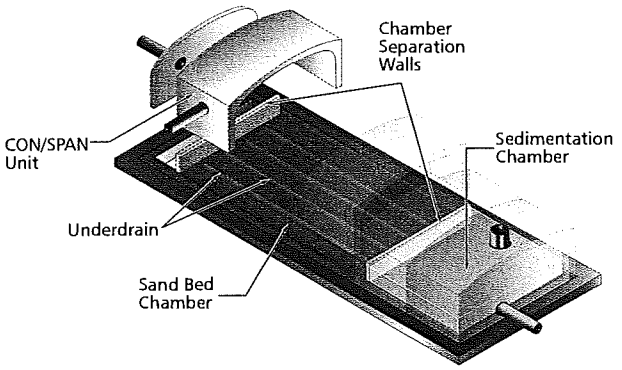


CON/STORM

CON/SPAN SAND FILTER

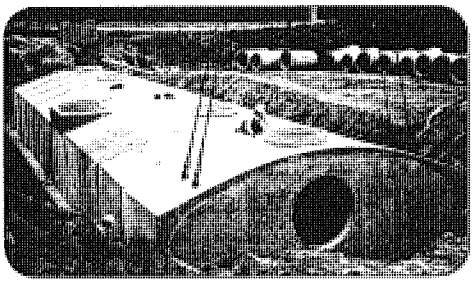
The versatility of the CON/SPAN structure makes it ideal to serve as a containment vessel in a wide variety of applications. Historically, the system has been used for a below-grade command center and as a wine cave. In addition, CON/SPAN has been used as the structural shell for a wide variety of stormwater treatment applications, including sand filters. Simple adaptation of the CON/SPAN system offers the flexibility to design for sand filters according to common standards, such as those found in Maryland, Delaware, New York, Austin, Urban Drainage and elsewhere. Cast-in-place or precast walls are installed to separate the sedimentation, sand bed, and outlet bays.

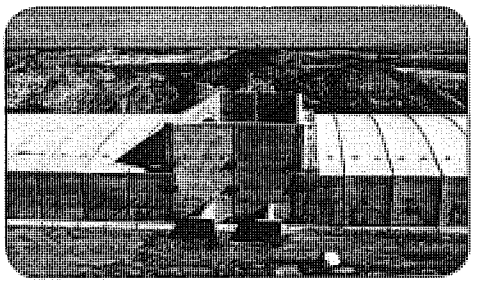


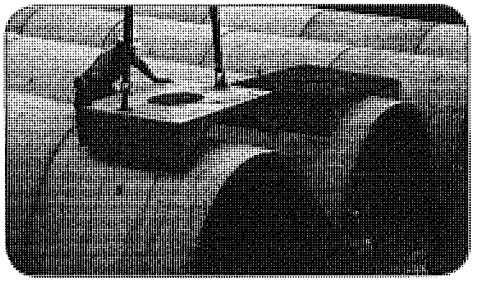


MAINTENANCE

The CON/SPAN and CON/STORM systems are designed for ease of maintenance access. Manhole and other access openings are a common feature and can be located in the center of the units or along walls to allow for ladder access. The CON/SPAN system can also be equipped with a large opening between units that would allow for maintenance equipment to be lowered into the system. The CON/STORM system comes equipped with a separate manhole collar, which provides a level surface to bring risers to grade. All of these features combine to make the inside of CON/STORM and CON/SPAN systems readily accessible throughout the life of the system.







FLOW ROUTING

Proper design of any detention system typically requires that a flow routing be performed. Engineers at CONTECH can be a valuable resource when designing a CON/SPAN or CON/STORM detention system. Typically stage-storage curves like those shown below are utilized in the analysis. CONTECH will provide these Microsoft Excel®-based spreadsheets for any span, rise and length combination for either CON/SPAN or CON/STORM. This information can simply be inserted into common hydrology/hydraulic software such as HydroFlow, PondPack, or TR20. This makes a flow routing design with CON/SPAN and CON/STORM just as simple as an above-ground pond design. CONTECH can also provide a copy of the CON/SPAN hydrology and hydraulic tools – software designed at the University of Dayton. Ask for details.

Stage / Storage Tables

CON/STORM 8'-0" span x 6'-0" rise - STAGE/STORAGE

Description	Elevation (ft)	Incremental Area (sf)	Cumulative Area (sf)	Incremental Volume (cf)	Cumulative Volume (cf)	Cumulative Volume (ac-ft)
Top of Base Slab	0.00	0.00	0.00	0	0	0.00
	0.42	3.32	3.32	332	332	0.01
	0.92	3.93	7.25	393	725	0.02
	1.42	3.85	11.10	385	1110	0.03
	1.92	3.74	14.84	374	1484	0.03
	2.42	3.60	18.44	360	1844	0.04
	2.92	3.43	21.87	343	2187	0.05
	3.42	3.23	25.10	323	2510	0.06
	3.92	2.99	28.09	299	2809	0.06
	4.42	2.71	30.80	271	3080	0.07
	4.92	2.39	33.19	239	3319	0.08
	5.42	1.94	35.13	194	3513	0.08
Inside Top of Arch	5.92	1.12	36.25	112	3625	0.08

Total contributory length of storage structure = 100 ft
Storage Volume Provided = 3625 cf

CON/SPAN 24' span X 11'-0" rise - STAGE/STORAGE

Description	Elevation (ft)	Incremental Area (sf)	Cumulative Area (sf)	Incremental Volume (cf)	Cumulative Volume (cf)	Cumulative Volume (ac-ft)
Top of Base Slab	100.00	0.00	0.00	0.00	0	0.000
	100.50	12.00	12.00	1200.00	2400	0.055
	101.00	12.00	24.00	1200.00	4800	0.110
	101.50	12.00	36.00	1200.00	7200	0.165
	102.00	12.00	48.00	1200.00	9600	0.220
	102.50	12.00	60.00	1200.00	12000	0.275
	103.00	12.00	72.00	1200.00	14400	0.331
	103.50	12.00	84.00	1200.00	16800	0.386
	104.00	12.00	96.00	1200.00	19200	0.441
	104.50	12.00	108.00	1200.00	21600	0.496
	105.00	12.00	120.00	1200.00	24000	0.551
	105.50	12.00	132.00	1200.00	26400	0.606
	106.00	12.00	144.00	1200.00	28800	0.661
	106.50	11.99	155.99	1199.00	31198	0.716
	107.00	11.92	167.91	1192.00	33582	0.771
	107.50	11.76	179.67	1176.00	35934	0.825
	108.00	11.48	191.15	1148.00	38230	0.878
	108.50	11.06	202.21	1106.00	40442	0.928
	109.00	10.32	212.53	1032.00	42506	0.976
	109.50	9.18	221.71	918.00	44342	1.018
	110.00	7.79	229.50	779.00	45900	1.054
	110.50	6.03	235.53	603.00	47106	1.081
Inside Top of Arch	111.00	3.32	238.85	332.00	47770	1.097

Top of Slab Elev. = **100.00**

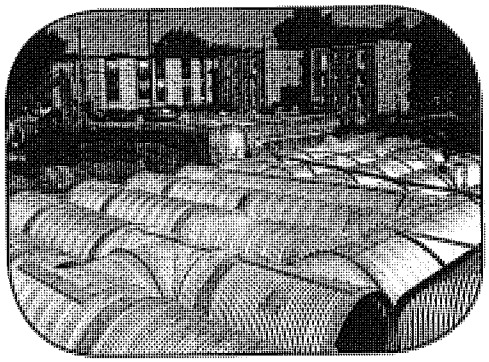
Length of Storage Vault = **200.00**

CONTECH can provide these Excel based spreadsheets for any span rise and length combination for either CON/SPAN or CON/STORM.

CMP Detention

CONTECH CMP DETENTION SYSTEMS

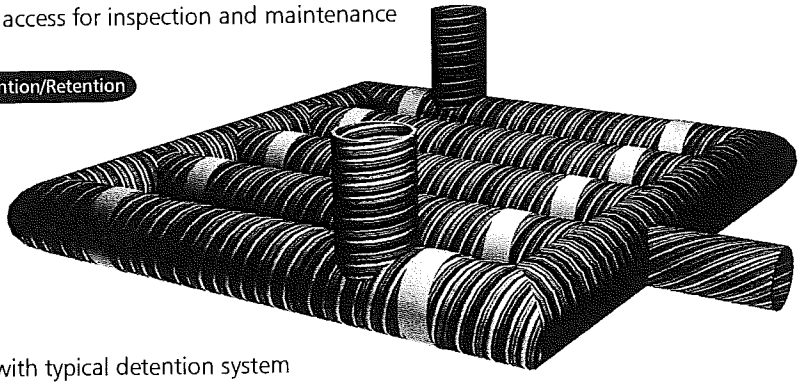
CONTECH Stormwater Solutions corrugated metal pipe (CMP) underground detention/retention systems can be sized and shaped to meet most site-specific storage needs. The versatile material provides almost limitless opportunities to match individual site requirements while lowering site development costs.



CONTECH CMP Detention/Retention Systems

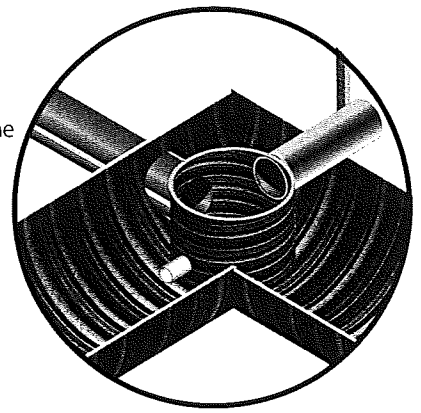
- Flexible configurations and coatings for site-specific footprints and conditions
- Available in larger diameters than other materials
- Lightweight, cost-effective material offers low cost per cubic foot of storage
- Easy to access for inspection and maintenance

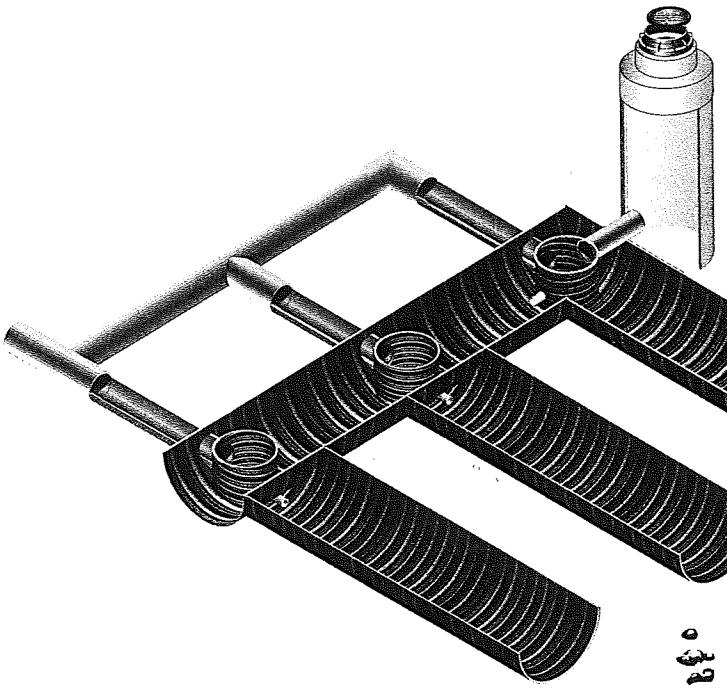
CMP Detention/Retention



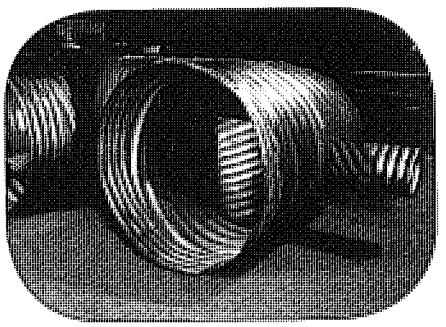
Optimizer™

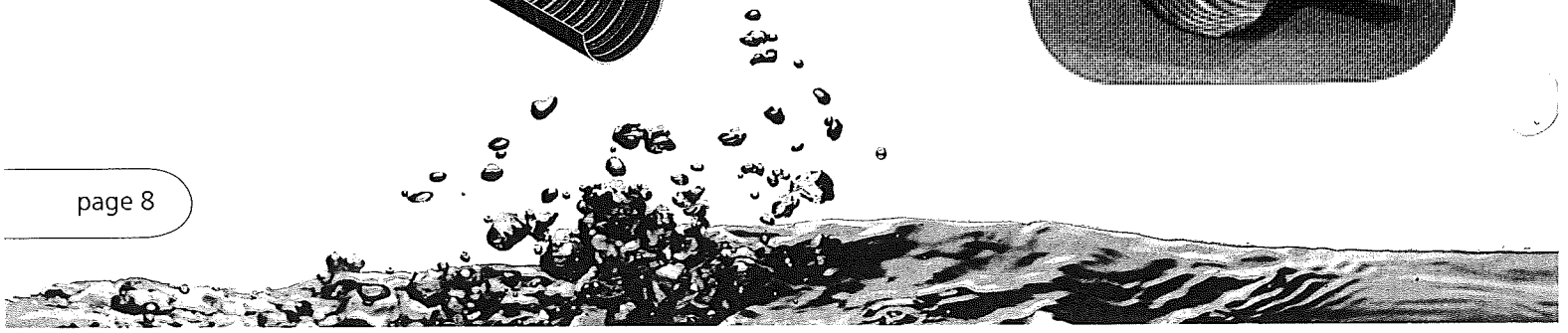
- Innovative flow control technology used in conjunction with typical detention system
- Series of 3 surge tanks that use pressure head to begin immediately discharging runoff at maximum allowable flow rates
- Can reduce the size of standard detention systems up to 50%
- Ideal for tight sites as less pipe means a smaller footprint
- Less excavation and backfill lowers project costs and reduces install time





Optimizer





CMP VERSATILITY

With versatile layout, material type, coatings, shapes and sizes, CMP solutions provide almost limitless opportunities to match individual site requirements. Variable sizes, material economy, faster installation and durability combine to make CMP detention systems an economical method for controlling stormwater runoff.

Material

Aluminized Steel™ Type 2
Aluminized Steel™ Type 2 provides the ideal mix of economy and durability for most CMP detention systems.

More than 50 years of field testing confirm that Aluminized Steel Type 2 corrugated steel pipe (CSP) offers 75 years or more of maintenance-free service life in a pH range of 5.0 to 9.0 with resistivities as low as 1,500 ohm-cm. When hot-dipped in commercially pure aluminum, a passive aluminum-oxide reaction creates a film that provides excellent protection. Field installations more than 50 years old have shown that this material provides a service life three to 10 times longer than plain galvanized steel.

Galvanized
Galvanizing is a widely used and economical metallic coating for CSP. In addition to forming a physical barrier against corrosion, the zinc coating sacrifices itself slowly by galvanic action to protect the base metal. This sacrificial action continues as long as any zinc remains. Optimal conditions is a pH range of 5.8 to 10 with soil resistivity greater than 2000 ohm-cm and water resistivity in the range of 2000 ohm-cm to 8000 ohm-cm.

CORLIX® (Aluminum Pipe)
Corrugated aluminum pipe is made of rugged core aluminum alloy 3004–H32 or H34 that is clad on both sides with alloy 7072 to protect the pipe physically and electrochemically against corrosion. When backfilled with a free-draining granular material, the pipe can perform well in marine environments. A 75-year service life is expected when the soil and water in contact with the pipe has a pH in the range of 4 to 9 and a resistivity greater than 500 ohm-cm. In addition, the light weight of aluminum makes for an easier and faster installation with longer pipe lengths.

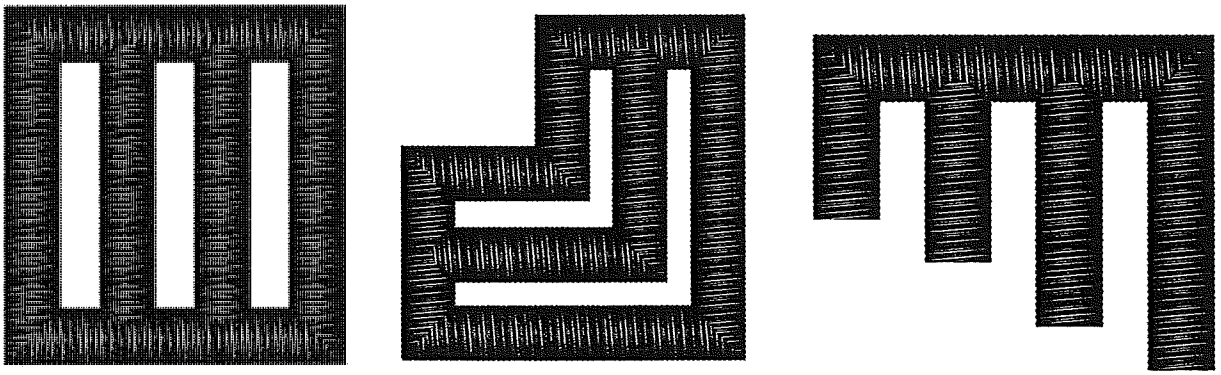
TRENCHCOAT® (Polymer-Coated Steel)
This heavy-gauge protective film offers long–term protection. Even under harsh conditions, it protects against abrasion and corrosion to provide at least 100 years of service life within a pH range of 5.0 to 9.0 with a resistivity greater than 1500 ohm-cm. Bonded to both the inside and outside of CONTECH's galvanized CSP, the film serves as a protective barrier – resisting corrosion from acids, salts, and alkalis found in today's storm sewers and culverts.

Shape

CMP is available in both round pipe and pipe-arch shapes. Pipe-arch provides maximum storage volume in low headroom situations.

Layout

CMP underground detention/retention systems can be sized and shaped to meet most site-specific storage needs. A wide variety of layouts including rectangular, L-shapes and staggered cells are frequently utilized.

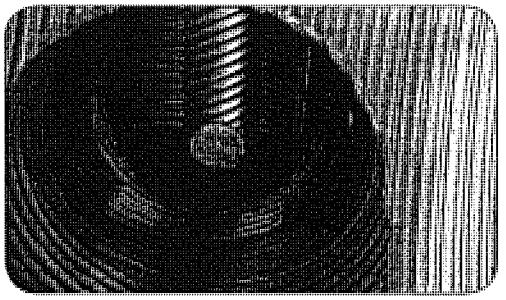


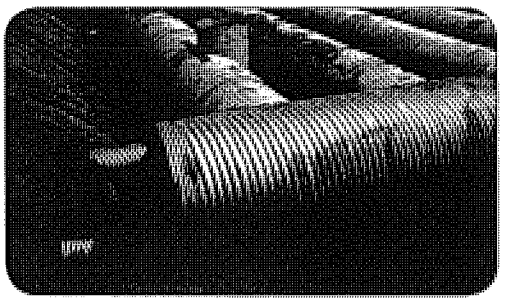
Outlet Control and Maintenance

The versatility of CONTECH CMP systems allows for an outlet control structure to be integrated directly into the piping.

The two most common methods for creating this release structure are through an internal bulkhead and outlet control tee. An internal bulkhead provides a vertical wall, in which openings such as an orifice or overflow weir can be cut to allow for proper release rates. A stand pipe with outlet tee, provides for a low flow orifice in the tee, and an overflow through the top of the standpipe. Integration of either assembly into the CMP detention system eliminates the need for a downstream outlet control structure, reducing costs and maximizing land use.

CMP systems may be equipped with manhole riser sections, complete with ladders, to facilitate any access and scheduled maintenance of the systems.





SIZING

Round Pipe - CMP and Plate (CMP → 12-in to 144-in; Plate → 60-in to 240-in)

Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height	Diameter (inches)	Volume (ft^3/ft)	Min. Cover Height
12	.78	12"	60	19.6	12"	120	78.5	18"	180	176	24"
15	1.22	12"	66	23.7	12"	126	86.5	18"	186	188	24"
18	1.76	12"	72	28.2	12"	132	95.0	18"	192	201	24"
21	2.40	12"	78	33.1	12"	138	103.8	18"	198	213	30"
24	3.14	12"	84	38.4	12"	144	113.1	18"	204	227	30"
30	4.9	12"	90	44.1	12"	150	122	24"	210	240	30"
36	7.0	12"	96	50.2	12"	156	132	24"	216	254	30"
42	9.6	12"	102	56.7	18"	162	143	24"	222	268	30"
48	12.5	12"	108	63.6	18"	168	153	24"	228	283	30"
54	15.9	12"	114	70.8	18"	174	165	24"	234	298	30"
									240	314	30"

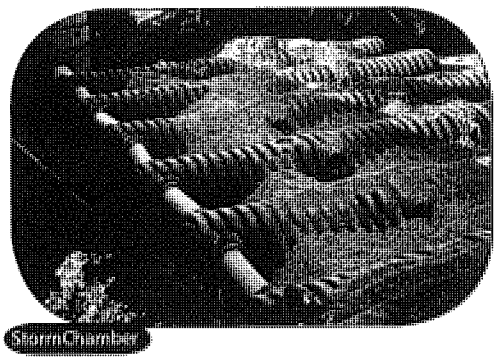
Pipe Arch - CMP

1/2" Deep Corrugations											
Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (inches)	Volume (ft^3/ft)	Min. Cover Height
17 x 13	1.1	12"	28 x 20	2.9	12"	49 x 33	8.9	12"	71 x 47	18.1	12"
21 x 15	1.6	12"	35 x 24	4.5	12"	57 x 38	11.6	12"	77 x 52	21.9	12"
24 x 18	2.2	12"	42 x 29	6.5	12"	64 x 43	14.7	12"	83 x 57	26.0	12"
1" Deep Corrugations											
60 x 46	15.6	15"	81 x 59	27.4	18"	103 x 71	42.4	18"	128 x 83	60.5	24"
66 x 51	19.3	15"	87 x 63	32.1	18"	112 x 75	48.0	21"	137 x 87	67.4	24"
73 x 55	23.2	18"	95 x 67	37.0	18"	117 x 79	54.2	21"	142 x 91	74.5	24"

Pipe Arch - Multi Plate

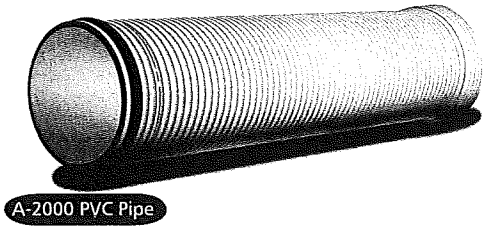
2" Deep Corrugations												
	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height	Shape (Inches)	Volume (ft^3/ft)	Min. Cover Height
18-in Corner Radius (Rc)	6-1 x 4-7	22	12"	8-7 x 5-11	41	18"	8-7 x 5-11	41	18"	14-1 x 8-9	97	24"
	6-4 x 4-9	24	12"	8-10 x 6-1	43	18"	8-10 x 6-1	43	18"	14-3 x 8-11	101	24"
	6-9 x 4-11	26	12"	9-4 x 6-3	46	18"	9-4 x 6-3	46	18"	14-10 x 9-1	105	24"
	7-0 x 5-1	29	12"	9-6 x 6-5	49	18"	9-6 x 6-5	49	18"	15-4 x 9-3	109	24"
	7-3 x 5-3	31	12"	9-9 x 6-7	52	18"	9-9 x 6-7	52	18"	15-6 x 9-5	114	24"
	7-8 x 5-5	33	12"	10-3 x 6-9	55	18"	10-3 x 6-9	55	18"	15-8 x 9-7	118	24"
	7-11 x 5-7	36	12"	10-8 x 6-11	58	18"	10-8 x 6-11	58	18"	15-10 x 9-10	122	24"
	8-2 x 5-9	38	18"	10-11 x 7-1	61	18"	10-11 x 7-1	61	18"	16-5 x 9-11	126	30"
							13-11 x 8-7	93	24"	16-7 x 10-1	131	30"
31-in Corner Radius (Rc)	13-3 x 9-4	98	24"	15-4 x 10-4	124	24"	17-2 x 11-4	153	30"	19-3 x 12-4	185	30"
	13-6 x 9-6	102	24"	15-7 x 10-6	129	24"	17-5 x 11-6	158	30"	19-6 x 12-6	191	30"
	14-0 x 9-8	106	24"	15-10 x 10-8	134	24"	17-11 x 11-8	163	30"	19-8 x 12-8	196	30"
	14-2 x 9-10	111	24"	16-3 x 10-10	138	30"	18-1 x 11-10	168	30"	19-11 x 12-10	202	30"
	14-5 x 10-0	115	24"	16-6 x 11-0	143	30"	18-7 x 12-0	174	30"	20-5 x 13-0	208	36"
	14-11 x 10-2	120	24"	17-0 x 11-2	148	30"	18-9 x 12-2	179	30"	20-7 x 13-2	214	36"

Plastic Detention



StormChamber™

- High capacity chambers result in fewer chambers and smaller footprint than other plastic systems
- Direct connect side portals eliminate expensive header pipe manifolds along with related extra excavation and stone
- Inspection and clean out risers available at numerous locations
- Integrated end walls prevent the need for additional pieces to install
- Lightweight structures installed without the use of construction equipment



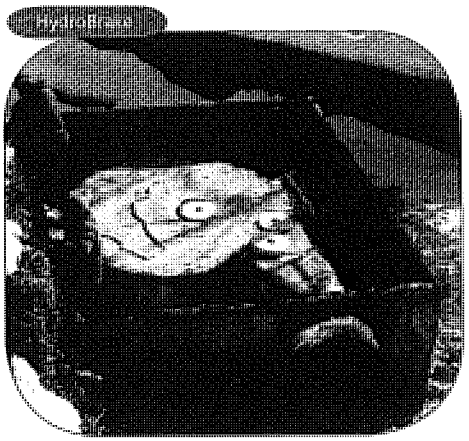
A-2000™

- Exceeds durability and service life of HDPE piping materials
- Stable profile not subject to local buckling
- Offers excellent resistance to conventional corrosion and abrasion
- Joints are rated for sanitary sewer and prevent leakage
- Labor costs reduced by lighter weight and easy handling

Additional Products

HydroBrake

- Simple, straight-forward design precisely regulates flows for a variety of applications
- Anti-clogging design makes it ideal for use in outlet control structures
- Stainless steel construction ensure durability



StormGate™

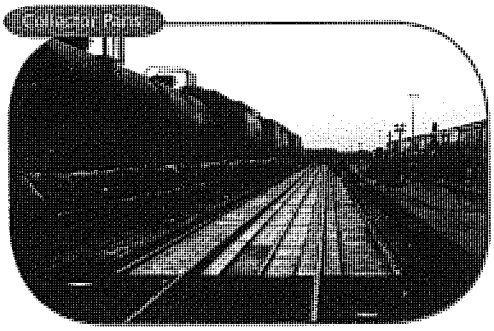
- Directs high flow, away from treatment system
- Field-adjustable weir and orifice precisely control system hydraulics
- Minimizes flow pulsing when installed upstream of water quality or pretreatment facilities

Cathbasin Inserts

- Cost-effective, first line of defense treatment system
- Drop inlet, curb inlet and sediment control models available in a variety of sizes
- Cam-lock filter cartridges easily removed and replaced during maintenance

Oil Stop Valve

- Reduces the risk of catastrophic oil spills being released from site
- Uses existing storm drains and pipes as secondary containment
- Modular manhole design is simple to install



Oil Collector Pans

- Control soil contamination at rail sites
- Available in a variety of materials to meet most application criteria
- Simple installation–minimum track downtime
- Modular system–if damaged, only damaged section needs to be replaced

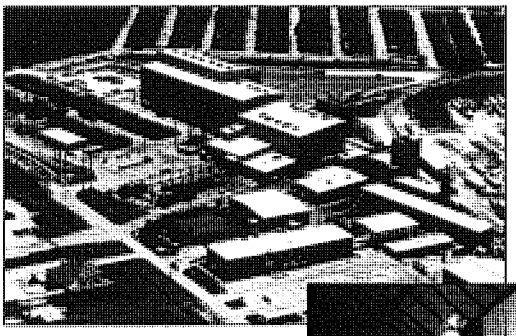
GSE GeoStorage The Next Genera

Introduction

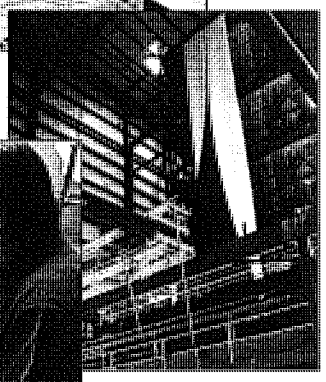
The use of underground stormwater detention systems is rapidly expanding as builders are challenged with escalating development costs and stiffening regulations. GSE Lining Technology, Inc. is leading the way in new technology with GSE GeoStorage, the Next Generation in underground detention and retention systems.

GSE GeoStorage offers land developers cost savings over traditional systems in a significantly smaller footprint. The footprint size, configuration and depth can be customized for each individual site. This unique, patent pending design concept provides a large chamber for easy access and maintenance, an important consideration to owners and public works departments. GSE products are manufactured to perform in the most aggressive environments. For added reliability, GSE GeoStorage is backed by an experienced team of engineering and construction professionals ready to exceed the customer's expectation.

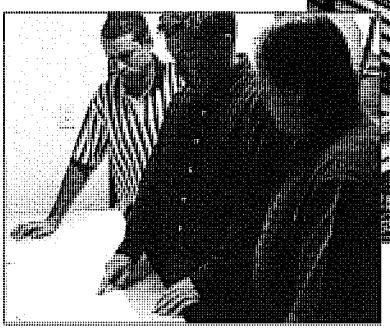
GSE has been a leading, global geosynthetic manufacturer and installer for over 30 years. GSE offers a broad array of geosynthetic products and innovative installation techniques to perform in the environmental and civil markets. GSE has a worldwide network of professionals to make your project a success no matter where your project is located.



GSE Corporate Headquarters, Houston, Texas



GSE Manufacturing Facility

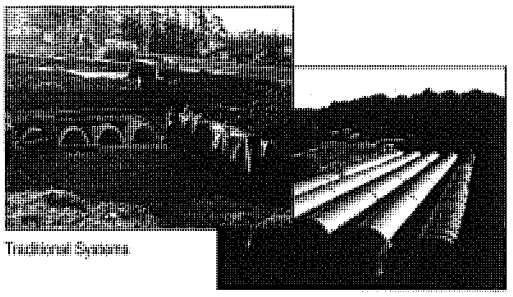


GSE Engineering Staff at work

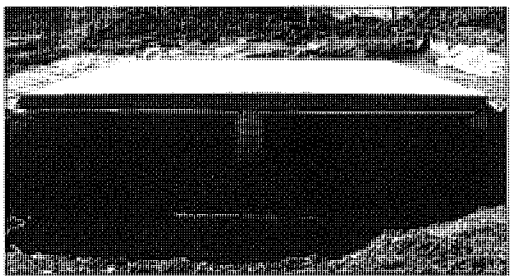
Traditional Systems versus The Next Generation System

Pipes and pipe arches comprise most traditional underground storm water detention systems. Flexible plastic and metal pipes require a compacted structural backfill above, below and around the pipe resulting in additional costs and a large footprint.

GSE GeoStorage, the Next Generation, utilizes AASHTO (American Association of State Highway and Transportation Officials) standards to design a large, deep underground storage chamber. Walls and columns are constructed with open graded stone to eliminate pore pressures and provide additional storage capacity. The efficiency of GSE GeoStorage reduces costs and the size of the excavation. The cost advantage improves on projects with a rock sub-grade or where excess fill must be hauled off-site. In applications such as split level mall parking lots, where passenger vehicle loads can be assumed rather than HS-20 highway loads, the savings can be even more considerable. Where a water tight system is required, GSE has been lining hazardous and municipal waste landfills for 30 years.

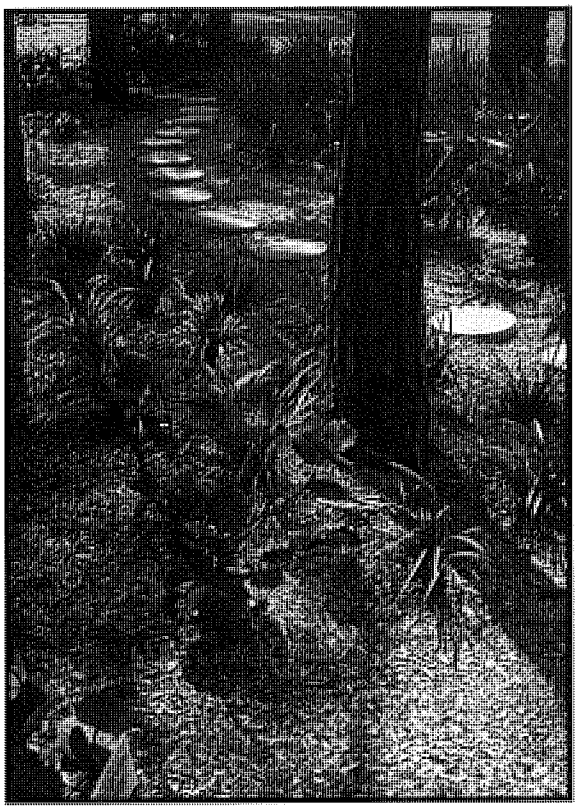


Traditional Systems



GSE GeoStorage System

Site Design & Landscape Planning SD-10



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

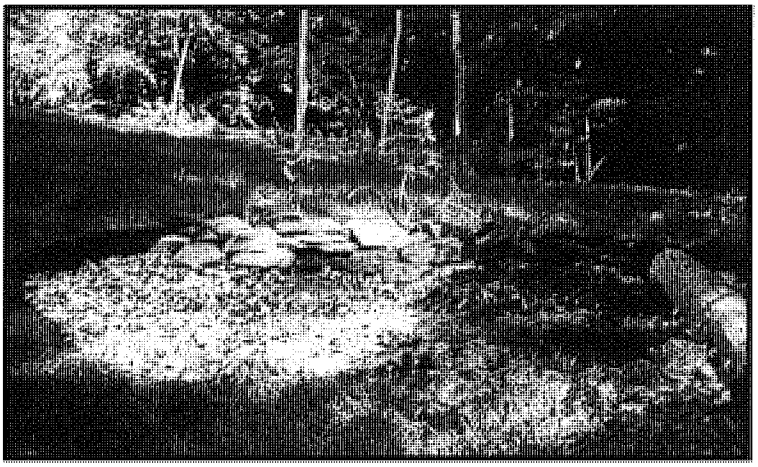
Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11



Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

ATTACHMENT E

Geotechnical Certification Sheet

The design of stormwater treatment and other control measures proposed in this plan requiring specific soil infiltration characteristics and/or geological conditions has been reviewed and approved by a registered Civil Engineer, Geotechnical Engineer, or Geologist in the State of California.

_____ _____

Name Date

Krazan & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

May 10, 2005

Project No. 114-05035

Ms. Ginger Dix
Summit Builders
4700 Von Karman Avenue, Suite 100
Newport Beach, CA 92660

RECEIVED
MAY 11 2005
SUMMIT BUILDERS
NEWPORT BEACH

Re: Phase I Environmental Site Assessment
Approximately 153-Acre Vacant Parcel of Land
NWC of Otay Mesa and Harvest Roads
Unincorporated San Diego County, CA

Dear Ms. Dix:

Krazan & Associates, Inc., (Krazan) completed a Phase I Environmental Site Assessment at the above-referenced site, summarized in our report dated May 10, 2005. We appreciate the opportunity to serve your environmental due diligence needs. During the course of this assessment, Krazan identified the following evidence of Recognized Environmental Conditions as defined by ASTM E-1527-00 in connection with the subject site:

- The northwest corner of the subject site is occupied by a single-family residential structure and associated truck farm at 6495 Lone Star Road. The truck farm comprised a gravel parking lot adjoining the residential structure to the east. At the time of Krazan's site reconnaissance, five tanker trucks were stored in the truck farm area and one empty 1,000 gallon steel aboveground storage tank (AST) was located south of the residential structure. It appeared that commercial vehicle maintenance activities are being conducted on the subject site. Additionally, moderate quantities of paints and paint-related materials are stored in various locations around the exterior of the residential structure. Only minor surface staining of the soil was observed in the paint storage areas and within the truck farm area. Krazan recommends conducting a Limited Soil Assessment (LSA) in the truck farm area and paint storage areas to determine if on-site shallow soils have been impacted by petroleum hydrocarbons and solvents.

- A septic system and domestic water well are likely associated with the on-site dwelling located near the northwest corner of the subject site. However, it is unknown if a septic system or water well is currently located in the vicinity of the on-site dwelling. The presence of a septic system generally is not anticipated to adversely impact the subject site due to its use for domestic purposes only. However, given the apparent commercial use of the property for vehicle maintenance activities, a septic system has the potential to provide a migration pathway for hazardous materials utilized in on-site vehicle maintenance operations into the soil and groundwater beneath the subject site. If a septic system or domestic water well is identified during the redevelopment of the subject site, then the septic system and domestic water well should be properly abandoned/closed or destroyed in accordance with local and state guidelines. Additionally, Krazan recommends conducting a LSA in the vicinity of the septic system to

evaluate whether on-site soils have been impacted by hazardous materials which may have been disposed of into the septic system.

- Review of historical aerial photographs and visual observations made during Krazan's site reconnaissance indicate that the subject site was utilized for agricultural purposes for the cultivation of row crops from at least 1953 to approximately 1994. Agricultural chemicals in use today are applied in dilute concentrations and when used properly degrade relatively quickly. However, environmentally-persistent pesticides used in the past can linger in the soil for many years. It is not known if environmentally-persistent pesticides have been applied to the row crops grown on the subject site in the past. Generally, sampling and analysis of surface soils from properties with similar agricultural histories has typically yielded non-detectable concentrations of environmentally-persistent pesticides. Therefore, the potential for elevated concentrations of environmentally-persistent pesticides to exist in the near-surface soils of the subject site, which would require regulatory action, appears to be low. However, in order to verify the potential concentrations of environmentally-persistent pesticides in the subject site's near-surface soils, Krazan recommends conducting a LSA to identify environmentally-persistent pesticides and herbicides which may have been used in past on-site agricultural operations.

Additionally, the following Business Environmental Risk items were identified:

- Based upon the past use of the subject site for agricultural purposes, agricultural wells are likely to be located on the subject site. During Krazan's site reconnaissance, no agricultural wells were observed on the subject site. However, prior to the redevelopment of the subject site, Krazan recommends that agricultural wells (if any) be abandoned in accordance with all applicable state and local regulations.

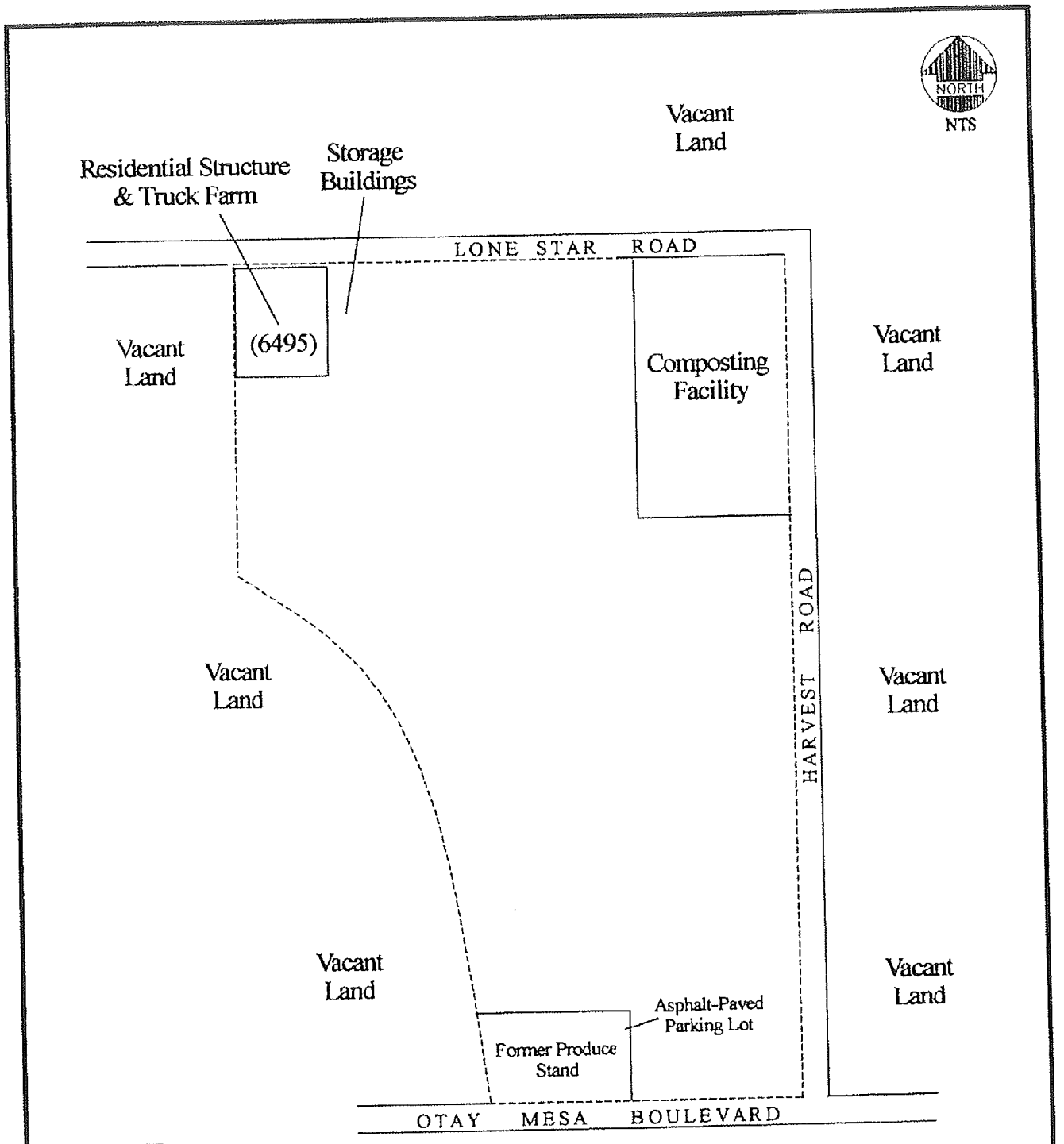
- Based upon the age of the residential structure located on the subject site, it is likely that asbestos containing materials (ACMs) and lead-based paint (LBP) may have historically been utilized for the construction and maintenance of the single-family dwelling. Therefore, Krazan recommends conducting a pre-demolition asbestos and LBP survey of the residential structure.

Our firm specializes in full-service Land Development Engineering with considerable project management experience. We look forward to putting the strengths of Krazan to work toward the completion of your site development.

Respectfully Submitted:
KRAZAN & ASSOCIATES, INC.

Richard P. Opp, JD, CHMM, REA
Environmental Division Manager

MGR/CJ



LEGEND

-------- Subject Site Boundary

153-ACRE VACANT LAND **NWC OTAY MESA AND HARVEST ROADS** **OTAY MESA, CALIFORNIA**	Scale: NTS	Date: 05/2005	Kazan SITE DEVELOPMENT ENGINEERS Offices Serving the Western United States
	Drawn by: MGR	Approved by: RPO	
SITE MAP	Project No: 114-05035	Figure No: 3	

ATTACHMENT F

Maintenance Plan

(Use Chapter 5 of the SUSMP as guidance in developing your Maintenance Plan)

The following is a general outline for to create your project specific Maintenance Plan.

I. Inspection, Maintenance Log and Self-Verification Forms (Examples are provided in Appendix F of the San Diego County SUSMP)

II. Updates, Revisions and Errata

III. Introduction

A. Narrative overview describing the site; drainage areas, routing, and discharge points; and treatment facilities.

IV. Responsibility for Maintenance

A. General

(1) Name and contact information for responsible individual(s).

(2) Organization chart or charts showing organization of the maintenance function and location within the overall organization.

(3) Reference to Operation and Maintenance Agreement (if any). A copy of the agreement should be attached.

(4) Maintenance Funding

(1) Sources of funds for maintenance

(2) Budget category or line item

(3) Description of procedure and process for ensuring adequate funding for maintenance

B. Staff Training Program

C. Records

D. Safety

V. Summary of Drainage Areas and Stormwater Facilities

A. Drainage Areas

(1) Drawings showing pervious and impervious areas (copied or adapted from initial SWMP).

(2) Designation and description of each drainage area and how flow is routed to the corresponding facility.

B. Treatment and Flow-Control Facilities

(1) Drawings showing location and type of each facility

(2) General description of each facility (Consider a table if more than two facilities)

(1) Area drained and routing of discharge.

(2) Facility type and size

VI. Facility Documentation

A. "As-built" drawings of each facility (design drawings in the draft Plan)

B. Manufacturer's data, manuals, and maintenance requirements for pumps, mechanical or electrical equipment, and proprietary facilities (include a "placeholder" in the draft plan for information not yet available).

C. Specific operation and maintenance concerns and troubleshooting

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule for each facility with specific requirements for:

(1) Routine inspection and maintenance

(2) Annual inspection and maintenance

(3) Inspection and maintenance after major storms

B. Service Agreement Information

Assemble and make copies of your maintenance plan. One copy must be submitted to the County, and at least one copy kept on-site. Here are some suggestions for formatting the maintenance plan:

- Format plans to 8½" x 11" to facilitate duplication, filing, and handling.
- Include the revision date in the footer on each page.
- Scan graphics and incorporate with text into a single electronic file. Keep the electronic file backed-up so that copies of the maintenance plan can be made if the hard copy is lost or damaged.

▶ BIORETENTION FACILITIES

These facilities remove pollutants primarily by filtering runoff slowly through aerobic, biologically active soil. Routine maintenance is needed to ensure that flow is unobstructed, that erosion is prevented, and that soils are held together by plant roots and are biologically active. Typical maintenance consists of the following:

- Inspect **inlets** for channels, exposure of soils, or other evidence of erosion. Clear any obstructions and remove any accumulation of sediment. Examine rock or other material used as a splash pad and replenish if necessary.

- Inspect **outlets** for erosion or plugging.

- Inspect **side slopes** for evidence of instability or erosion and correct as necessary.

- Observe the surface of bioretention facility soil for uniform **percolation** throughout. If portions of the bioretention facility do not drain within 24 hours after the end of a storm, the soil should be tilled and replanted. Remove any debris or accumulations of sediment.

- Confirm that **check dams** and **flow spreaders** are in place and level and that rivulets and channelization are effectively prevented.

- Examine the **vegetation** to ensure that it is healthy and dense enough to provide filtering and to protect soils from erosion. Replenish mulch as necessary, remove fallen leaves and debris, prune large shrubs or trees, and mow turf areas. When mowing, remove no more than 1/3 height of grasses. Confirm that irrigation is adequate and not excessive and that sprays do not directly enter overflow grates. Replace dead plants and remove noxious and invasive vegetation.

- Abate any potential **vectors** by filling holes in the ground in and around the bioretention facility and by insuring that there are no areas where water stands longer than 48 hours following a storm. If mosquito larvae are present and persistent, contact the San Diego County Vector Control Program for information and advice. Mosquito larvicides should be applied only when absolutely necessary and then only by a licensed individual or contractor.

Operational & Maintenance Guidelines for Bio-Filters

The operational and maintenance needs of a Swale are:

- Vegetation management to maintain adequate hydraulic functioning and to limit habitat for disease-carrying animals.
- Animal and vector control.
- Periodic sediment removal to optimize performance.
- Trash, debris, grass trimmings, tree pruning, and leaf collection and removal to prevent obstruction of a swale.
- Removal of standing water, which may contribute to the development of aquatic plant communities or mosquito breeding areas.
- Erosion and structural maintenance to prevent the loss of soil and maintain the performance of a swale.

Inspection Frequency

The facility will be inspected and inspection visits will be completely documented:

- Once a month at a minimum.
- After every large storm (after every storm monitored or those storms with more than 0.50 inch of precipitation.)
- On a weekly basis during extended periods of wet weather.

Aesthetic and Functional Maintenance

Aesthetic maintenance is important for public acceptance of stormwater facilities. Functional maintenance is important for performance and safety reasons. Both forms of maintenance will be combined into an overall Stormwater Management System Maintenance.

Aesthetic Maintenance

The following activities will be included in the aesthetic maintenance program:

- Grass Trimming. Trimming of grass will be done on the swales, around fences, at the inlet and outlet structures, and sampling structures.
- Weed Control. Weeds will be removed through mechanical means. Herbicide will not be used because these chemicals may impact water quality.

Functional Maintenance

Functional maintenance has two components: preventive maintenance and corrective maintenance.

Preventive Maintenance

Preventive maintenance activities to be instituted at a Swale are:

- Trash and Debris. During each inspection and maintenance visit to the site, debris and trash removal will be conducted to reduce the potential for inlet and outlet structures and other components from becoming clogged and inoperable during storm events.
- Sediment Removal. Sediment accumulation, as part of the operation and maintenance program at a swale, will be monitored once a month during the dry season, after every large storm (0.50 inch), and monthly during the wet season. Specifically, if sediment reaches a level at or near plant height, or could interfere with flow or operation, the sediment will be removed. If accumulation of debris or sediment is determined to be the cause of decline in design performance, prompt action (i.e., within ten working days) will be taken to restore the Swale to design performance standards. Actions will include using additional fill and vegetation and/or removing accumulated sediment to correct channeling or ponding. Characterization and Appropriate disposal of sediment will comply with applicable local, county, state, or federal requirements. The swales will be regraded, if the flow gradient has changed, and then replanted with sod.
- Removal of Standing Water. Standing water must be removed if it contributes to the development of aquatic plant communities or mosquito breeding areas.
- Fertilization and Irrigation. Where appropriate, fertilizers and irrigation will be used to maintain the vegetation.
- Elimination of Mosquito Breeding Habitats. The most effective mosquito control program is one that eliminates potential breeding habitats.

Corrective Maintenance

Corrective maintenance is required on an emergency or non-routine basis to correct problems and to restore the intended operation and safe function of a Bio-filter. Corrective maintenance activities include:

- Removal of Debris and Sediment. Sediment, debris, and trash, which impede the hydraulic functioning of a bio-filter and prevent vegetative growth, will be removed and properly disposed. Temporary arrangements will be made for handling the sediments until a permanent arrangement is made. Vegetation will be re-established after sediment removal.
- Structural Repairs. Once deemed necessary, repairs to structural components of a bio-filter and its inlet and outlet structures will be done within 10 working days.

Qualified individuals (i.e., the designers or contractors) will conduct repairs where structural damage has occurred.

- Embankment and Slope Repairs. Once deemed necessary, damage to the embankments and slopes of bio-filters will be repaired within 10 working days).
- Erosion Repair. Where a reseeding program has been ineffective, or where other factors have created erosive conditions (i.e., pedestrian traffic, concentrated flow, etc.), corrective steps will be taken to prevent loss of soil and any subsequent danger to the performance of a bio-filter. There are a number of corrective actions than can be taken. These include erosion control blankets, riprap, sodding, or reduced flow through the area. Designers or contractors will be consulted to address erosion problems if the solution is not evident.
- Fence Repair. If applicable, repair of fences will be done within 30 days to maintain the security of the site.
- Elimination of Animal Burrows. Animal burrows will be filled and steps taken to remove the animals if burrowing problems continue to occur (filling and compacting). If the problem persists, vector control specialists will be consulted regarding removal steps. This consulting is necessary as the threat of rabies in some areas may necessitate the animals being destroyed rather than relocated. If the BMP performance is affected, abatement will begin. Otherwise, abatement will be performed annually in September.
- General Facility Maintenance. In addition to the above elements of corrective maintenance, general corrective maintenance will address the overall facility and its associated components. If corrective maintenance is being done to one component, other components will be inspected to see if maintenance is needed.

Debris and Sediment Disposal

Waste generated at the bio-filters is ultimately the responsibility of the California Crossing's Business Owners Association. Disposal of sediment, debris, and trash will comply with applicable local, county, state, and federal waste control programs.

Hazardous Waste

Suspected hazardous wastes will be analyzed to determine disposal options. Hazardous wastes generated onsite will be handled and disposed of according to applicable local, state, and federal regulations. A solid or liquid waste is considered a hazardous waste if it exceeds the criteria listed in the CCR, Title 22, Article 11.

CLEARWATER SOLUTIONS®, INC
2259 Lone Oak Lane
Vista, CA 92084
800-758-8817

"NPDES compliant now and in the future!"

MAINTENANCE GUIDELINES
For the ClearWater UNIT

INTRODUCTION

The ClearWater BMP unit is an important and effective component of your storm water management program and proper operation and maintenance of the unit is essential to demonstrate your compliance with local, state, and federal water pollution control requirements.

This is a patent-pending multi-media filtration design combined with pre-settling sedimentation containment and over flow by-pass protection. Water flow enters the unit and is directed into a pre-settling sedimentation chamber that collects heavy sediments and debris passing through the cover. Large trash and debris flow over the top into mesh trash baskets. The second and third sedimentation chamber is entered by the water flow to further settle lighter materials. The cleaner water then encounters the media filters. The media is a special blend of Perlite, Zeolite, and Activated Carbon that filters out a variety of organics, metals, and other contaminants from the runoff. Water then passes through the front of the treatment chamber into the catch basin. A properly maintained unit will achieve substantial reductions of contaminants from entering surface waters. To accomplish this, the filtration chamber is designed to handle 200 gpm through the media chamber, effectively handling up to 1" of rain per hour in a properly designed drain. Units strategically placed downstream from "hot spots" such as gas stations, parking lots and other industrial/commercial sites containing higher contaminate loadings, give municipalities and businesses an effective tool for reducing pollutants.

ClearWater BMP CLEANOUT

The frequency of cleaning the ClearWater BMP unit will depend upon the generation of trash and debris and sediments in your application. Cleanout and preventive maintenance schedules will be determined based on operating experience unless precise pollutant loadings have been determined. The unit should be periodically inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load being processed by the ClearWater BMP unit. Cleanouts have been averaging two times per year in Southern California.

NEW INSTALLATIONS

Check the condition of the unit after every runoff event for the first 90 days. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet), measuring the amount of solid materials that have accumulated in the trash collection nets and the amount of fine sediment accumulated in the settling areas. Schedules for inspections and cleanout should be based on storm events and pollutant accumulation.

ONGOING OPERATION
During the rainfall season, the unit should be inspected at least once every 60 days. The floatables should be removed and the settling areas cleaned when the primary settling chamber is 40%-50% full. If floatables accumulate more rapidly than the settleable solids, the floatables could be removed using a vactor truck. The trash baskets may need to be emptied more often, depending on the accumulation of larger trash and debris.

Cleanout of the ClearWater BMP unit at the end of a rainfall season is recommended because of the nature of pollutants collected and the potential for odor generation from the decomposition of material being collected and retained.

USE OF SORBENTS
The addition of sorbents is a unique enhancement capability special to ClearWater BMP units, enabling increased oil and grease capture efficiencies beyond that obtainable by conventional oil baffle systems.

RECOMMENDED OIL SORBENTS
The sorbent sock material should be replaced when it is fully discolored and hard from absorbing hydrocarbons. The sorbent may require disposal as a special or hazardous waste, but will depend on local and state regulatory requirements.

CLEANOUT AND DISPOSAL
A vactor truck is recommended for cleanout of the ClearWater BMP unit and can be easily accomplished in less than 15 minutes for most installations. Standard vactor operations should be employed in the cleanout of the ClearWater BMP unit. Disposal of material from the ClearWater BMP unit should be in accordance with the local municipality's requirements. Disposal of the decant material to a POTW is recommended. Field decanting to the storm drainage system is not recommended. Solids can be disposed of in a similar fashion as those materials collected from street sweeping operations and catch-basin cleanouts.

CONFINED SPACE
The ClearWater BMP unit is in a confined space environment and only properly trained personnel possessing the necessary safety equipment should enter the unit to perform maintenance or inspection procedures. Inspections of the components and maintenance procedures can, in most cases, be accomplished without confined space entry, through manhole access or directly through the curb inlet.

RECORDS OF INSTALLATION AND MAINTENANCE
CLEARWATER SOLUTIONS, INC. recommends that the owner maintain annual records of the operation and maintenance of the ClearWater BMP unit to document the effective maintenance of this important component of your storm water management program. The Installation and Maintenance Record form is suggested and should be retained for a minimum period of three years.

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800-758-8817

"NPDES compliant now and in the future!"

MAINTENANCE PROCEDURES OUTLINE
For the ClearWater BMP UNIT

Primary Items Requiring Maintenance:

1. Remove cover with attached Hydrocarbon Sock.
    a. Check for full absorption or not. Replace if hard when squeezed.
    b. Reuse or replace.
2. Remove Trash Collector Brackets and Nets.
    a. Remove trash and debris from nets.
    b. Check condition of collection nets and clips.
3. Vacuum the sediment areas of unit thoroughly.
4. Remove complete Filter Canister.
    a. Replace primary Filter Matt (Blue).
    b. Remove media filter bag, dispose and replace.
5. Replace Trash Baskets
6. Reinstall Cover

ClearWater BMP

Installation and Maintenance Record

Owner _____

Address _____

Owner representative _____

Date of Install _____ Model# _____ Serial # _____

Site Location _____

Media Types and Levels _____

Unit Modifications _____

Accessories _____

Inspections:

Date / Inspector	Visual	Trash Collection	Sediment Volume	Sorbent Condition

Comments: _____

_____

_____

Cleanout:

Date / Agent	Trash Collection	Primary Filter	Media Filter	Hydrocarbon Boom

Comments: _____

_____

_____

_____

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◇

ClearWater BMP

Installation and Maintenance Record

Owner _____

Address _____

Owner representative _____

Date of Install _____ Model# _____ Serial # _____

Site Location _____

Media Types and Levels _____

Unit Modifications _____

Accessories _____

Inspections:

Date / Inspector	Visual	Trash Collection	Sediment Volume	Sorbent Condition

Comments: _____

_____

_____

Cleanout:

Date / Agent	Trash Collection	Primary Filter	Media Filter	Hydrocarbon Boom

Comments: _____

_____

_____

_____

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◇

OPERATION & MAINTENANCE
Nutrient Separating Baffle Box

Maintenance: The Nutrient Separating Baffle Box is designed to allow for the use of vacuum removal of captured materials in the filter screens and sediment chambers, serviceable by centrifugal compressor vacuum units without causing damage to the filter or during normal cleaning and maintenance. Filters can be cleaned and vacuumed from the standard manhole access.

Maintenance Notes:

1. Bio Clean Environmental Services, Inc. recommends the Nutrient Separating Baffle Box be inspected a minimum of once every six months. The cleaning and debris removal maintenance a minimum of once year and replacement of hydrocarbon booms once a year. The procedure is easily done with the use of any standard vacuum truck.
2. Following maintenance and/or inspection, the maintenance operator shall prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of filter.
3. The owner shall retain the maintenance/inspection record for a minimum of five years from the date of maintenance. These records shall be made available to the governing municipality for inspection upon request at any time.
4. Any person performing maintenance activities must have completed a minimum of OSHA 24-hour hazardous waste worker (hazwoper) training.
5. Remove access manholes lid to gain access to filter screens and sediment chambers. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
6. Remove all trash, debris, and organics from the Nutrient Separating Screen with the vacuum hose.
7. The Nutrient Separating Screen has 3 hinged panels which will open into an upright position. This will expose the baffles. Using a vacuum hose, remove the sediment in the baffle chambers.
8. Evaluation of the hydrocarbon boom shall be performed at each cleaning. If the boom is filled with hydrocarbons and oils it should be replaced. Place new booms properly in media cage.
9. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
10. The hydrocarbon boom is classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

BIO CLEAN
ENVIRONMENTAL SERVICES, INC.

P O Box 869, Oceanside, CA 92049
(760 433-7640 Fax (760) 433-3176
www.biocleanenvironmental.net

KATCHALL FILTRATION SYSTEMS, LLC

475 EAST 13TH STREET – BEAUMONT, CA 92223 – 1501
PH (951) 769 – 0099 FX (951) 845 – 2771

Suggested Maintenance Procedures:

Dry Weather

- Visual inspections not less than once every three (3) months
- Remove, clean, and re-install as necessary

Wet Weather

- Visual inspections not less than once every month
- Remove, clean, and re-install as necessary

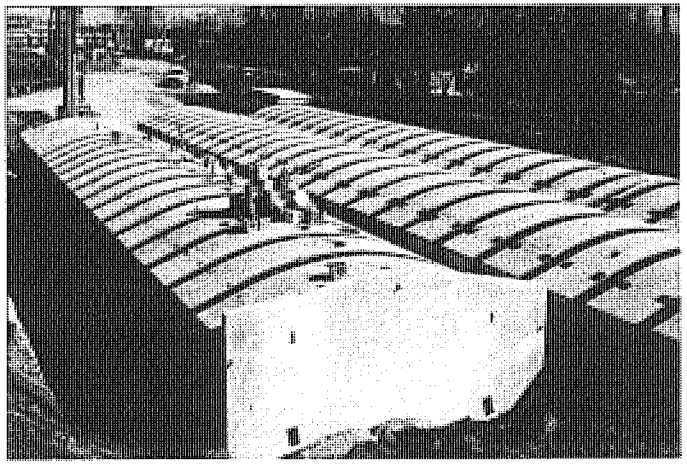
Contamination/Hydrocarbons

- When filtration media changes from light grayish coloration to a dull greenish-brown color, filters should be immediately removed and replaced.
- Removed filter media shall be properly disposed of according to applicable local, county, state, and federal waste control programs.
- Waste generated at California Crossings is ultimately the responsibility of the BOA.
- A secondary set of filtration media should be kept on-hand should any emergency arise requiring immediate replacement.

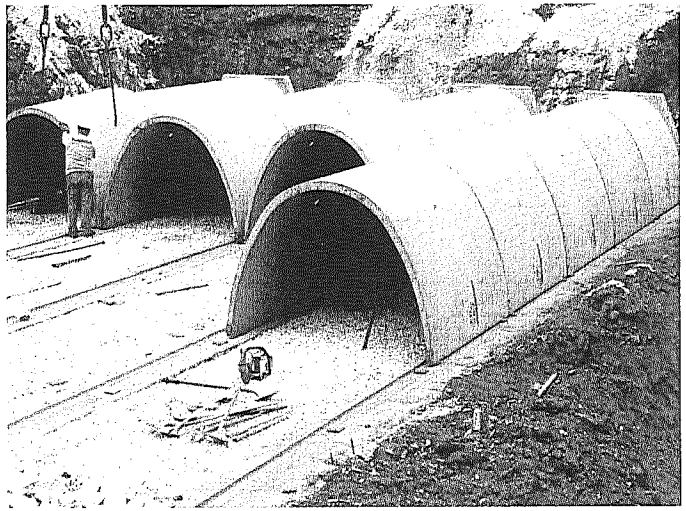
CONTECH STORMWATER SOLUTIONS INC.

Stormwater Detention/Retention Product Line Guide

CONCRETE

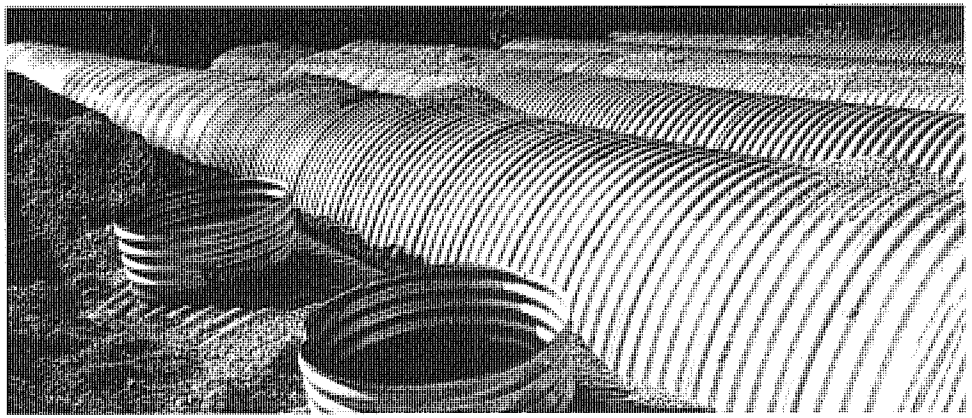


CON/SPAN® - Efficient arch-shape modular elements with minimal footprint



CON/STORM™ - Efficient arch-shaped lightweight structures - 2.65 tons per precast element

METAL



CONTECH CMP System - Versatile size, layout and material

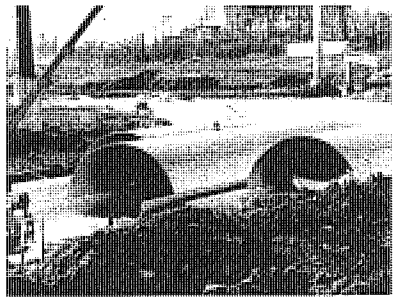
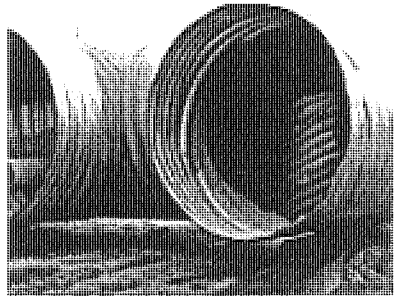
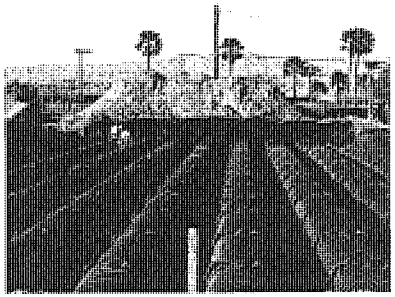


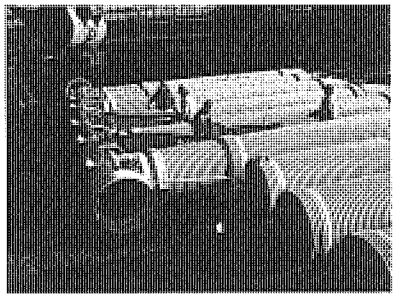
Plate System - Segmented construction; high vertical rise and minimal footprint



Optimizer™ - Unique stormwater storage reduction technology



StormChamber™ - Shallow installation without heavy equipment



A-2000™ System - High strength and tight joints

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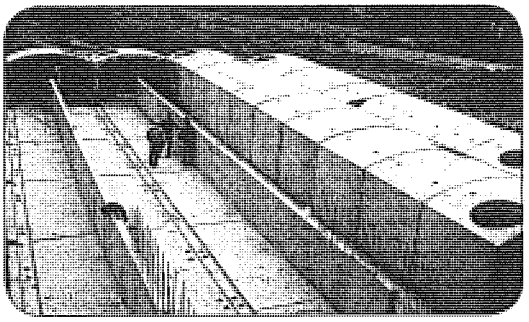
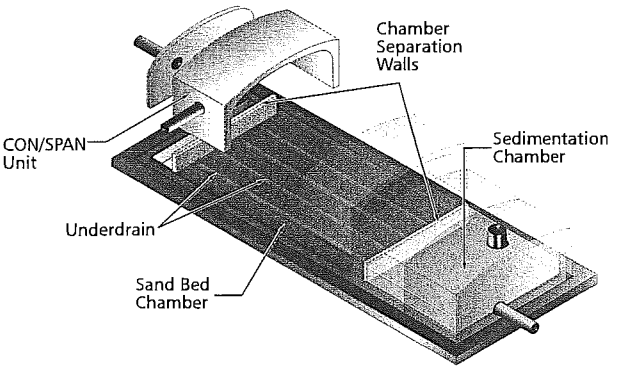
RECYCLED PAPER

CON/SPAN SAND FILTER

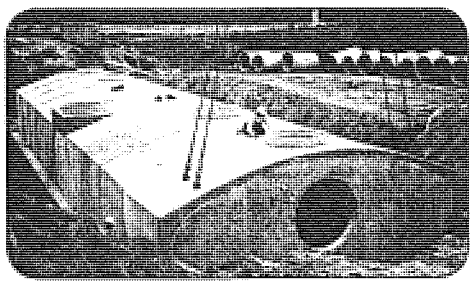
The versatility of the CON/SPAN structure makes it ideal to serve as a containment vessel in a wide variety of applications. Historically, the system has been used for a below-grade command center and as a wine cave. In addition, CON/SPAN has been used as the structural shell for a wide variety of stormwater treatment applications, including sand filters. Simple adaptation of the CON/SPAN system offers the flexibility to design for sand filters according to common standards, such as those found in Maryland, Delaware, New York, Austin, Urban Drainage and elsewhere. Cast-in-place or precast walls are installed to separate the sedimentation, sand bed, and outlet bays.

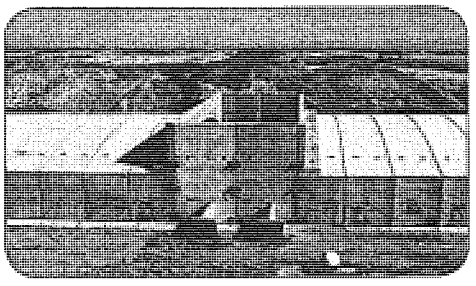


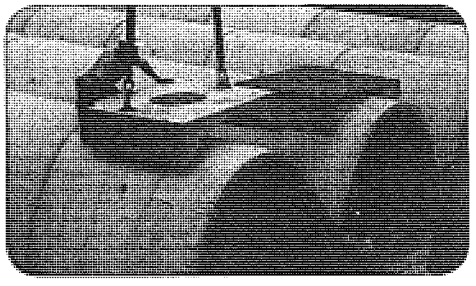


MAINTENANCE

The CON/SPAN and CON/STORM systems are designed for ease of maintenance access. Manhole and other access openings are a common feature and can be located in the center of the units or along walls to allow for ladder access. The CON/SPAN system can also be equipped with a large opening between units that would allow for maintenance equipment to be lowered into the system. The CON/STORM system comes equipped with a separate manhole collar, which provides a level surface to bring risers to grade. All of these features combine to make the inside of CON/STORM and CON/SPAN systems readily accessible throughout the life of the system.

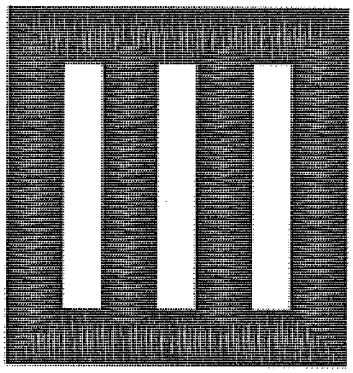


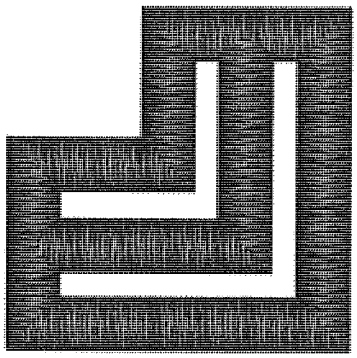


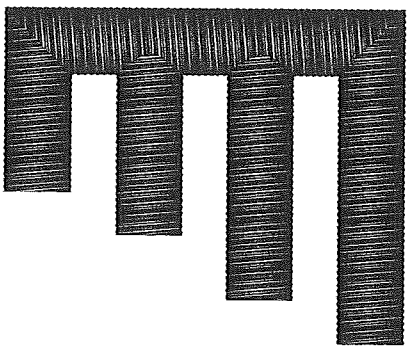


Layout

CMP underground detention/retention systems can be sized and shaped to meet most site-specific storage needs. A wide variety of layouts including rectangular, L-shapes and staggered cells are frequently utilized.





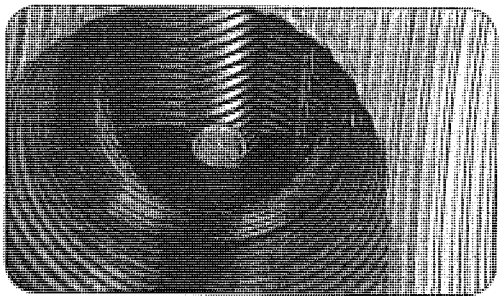


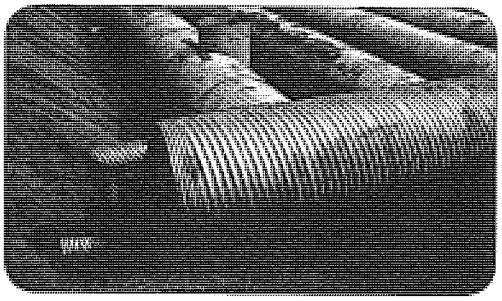
Outlet Control and Maintenance

The versatility of CONTECH CMP systems allows for an outlet control structure to be integrated directly into the piping.

The two most common methods for creating this release structure are through an internal bulkhead and outlet control tee. An internal bulkhead provides a vertical wall, in which openings such as an orifice or overflow weir can be cut to allow for proper release rates. A stand pipe with outlet tee, provides for a low flow orifice in the tee, and an overflow through the top of the standpipe. Integration of either assembly into the CMP detention system eliminates the need for a downstream outlet control structure, reducing costs and maximizing land use.

CMP systems may be equipped with manhole riser sections, complete with ladders, to facilitate any access and scheduled maintenance of the systems.





APPENDIX H Estimated O & M Costs for BMP Project

Estimated vlaues derived from Caltrans Pilot BMP Study. This spreadsheet will change as additional data becomes available.

						Labor			Equipment				Materials		Total	Comments
						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
BIOFILTER – STRIPS and SWALES																
Preventive Maintenance and Routine Inspections																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Height of vegetation	Average vegetation height exceeds 12 inches, emergence of trees, or woody vegetation	Visual inspection of vegetation throughout strip/swale	Once during wet season, once during dry season.(depending on growth)	Cut vegetation to an average height of 6 inches	Remove any trees, or woody vegetation.	10	43.63	436.3	one-ton truck & hydroseeder	2	26.84	53.68	string trimmer, rake, fork, bags, safety equipment	50	539.98	
Assess adequate vegetative cover	Less than 90 percent coverage in strip invert/swale or less than 70 percent on swale side slope	Visual inspection of strip/swale. Prepare a site schematic to record location and distribution of barren or browning spots to be restored. File the schematic for assessment of persistent problems.	Assess quantity needed in May each year late wet season and late dry season.	Reseed/revegetate barren spots by Nov.		8	43.63	349.04	one-ton truck & hydroseeder	1	48.15	48.15	seed	150	547.19	
				Scarify area to be restored, to a depth of 2-inches. Restore side slope coverage with hydroseed mixture.		0	43.63	0	one-ton truck & hydroseeder	0	26.84	0			0	
				If after 2 applications (2 seasons) of reseeding/revegetating and growth is unsuccessful both times, an erosion blanket or equivalent protection will be installed over eroding areas		0	43.63	0	one-ton truck & hydroseeder	0	26.84	0	blanket	0	0	
Inspect for debris accumulation	Debris or litter present	Visual observation	During routine trashing, per Districts schedule.	Remove litter, and debris.	None	0	0	0	one-ton truck & hydroseeder	0	0	0			0	
Inspect for accumulated sediment	Sediment at or near vegetation height, channeling of flow, inhibited flow due to change in slope.	Visual observation	Annually	Remove sediment. If flow is channeled, determine cause and take corrective action. If sediment becomes deep enough to change the flow gradient, remove sediment during dry season, characterize and properly dispose of sediment, and revegetate.		16	43.63	698.08	one-ton truck & hydroseeder	1	48.15	48.15	seed, testing and disposal of sediment	300	1046.23	once every three years

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						Labor			Equipment				Materials		Total	Comments
						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
				Notify engineer to determine if regrading is necessary. If necessary, regrade to design specification and revegetate swale/strip. If regrading is necessary, the process should start in May. Revegetate strip/swale in Nov. Target completion prior to wet season.	None	2	43.63	87.26				0			87.26	
Inspect for burrows	Burrows, holes, mounds	Visual observation	Annually and after vegetation trimming.	Where burrows cause seepage, erosion and leakage, backfill firmly.		0	0	0	one-ton truck & hydroseeder	0	26.84	0			0	
General Maintenance Inspection	Inlet structures, outlet structures, side slopes or other features damaged, significant erosion,emergence of trees, woody vegetation , fence damage, etc.	Visual observation	Semi-Annually, late wet season and late dry season.	Corrective action prior to wet season. Consult engineer if an immediate solution is not evident.	Remove any trees, or woody vegetation.	16	43.63	698.08	one-ton truck & hydroseeder	2	26.84	53.68			751.76	
TOTAL BIO FILTER AND SWALES						52		2268.76				203.66		500	2972.42	
BIO STRIP WITH SPREADER DITCH					Includes all the above plus the following.			0				0			0	
Inspect for standing water	Water accumulation in spreader ditch	Standing water in spreader ditch	Within 72 hours after a storm event 0.75 inches or greater.	De-water the spreader ditch to a depth of less than 0.25 inches. If sediment impedes the de-watering activity, then move or remove that portion of the sediment. Characterize and properly dispose.		3	43.63	130.89	0	0	0	0			130.89	
				De-water the spreader ditch to a depth of less than 0.25" by removing the bypass plug and allowing the water to drain into the infiltration trench. Use care to prevent sediment from discharging into the infiltration trench. Replace the bypass plug once the de-watering has been completed.		6	43.63	261.78	0	0	0	0			261.78	

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						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
				At the end of the wet season, remove the bypass plug and allow the spreader ditch to drain. Use care to prevent sediment from discharging into the infiltration trench. Remove, characterize, and dispose of sediment from the spreader ditch. Replace the bypass plug before the beginning of the wet season.		2	43.63	87.26	sedan	1	21.28	21.28	testing & disposal costs	200	308.54	
TOTAL BIO STRIP WITH SPREADER DITCH						55		2399.65				203.66		500	3103.31	
CONTINUOUS DEFLECTIVE SEPARATION (CDS) UNITS																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Inspect sump for accumulation of material.																
	or							0				0			0	
	When the sump is 50% full during two consecutive monthly inspections.							0				0			0	
	or															
	Annually in May, effect cleaning within 15 days			Empty unit		72	43.63	3141.36	one-ton truck & vactor	3	198.75	596.25	testing & disposal costs	1800	5537.61	
								0				0			0	
Inspect weir box for accumulation of material.	Presence of trash and debris	Visual observation	Monthly during the wet season	Remove trash and debris while onsite conducting inspection.		0	0	0		0	0	0		0	0	Hours accounted for during inspections
Inspect for standing water. (Include with all of inspection)	Standing water in sump	Visual observation	Annually, 72 hours after target2 storm (0.75 in)	If standing water cannot be removed or remains through the wet season notify VCD.	None											
Inspect the screen for damage and to ensure that it is properly fastened.	Screen becomes clogged, damaged or loose	Visual observation	Annually before wet season.	Clean screen.	None	0	0	0	0	0	0	0	0	0	0	Hours accounted for during inspections
Inspection for structural integrity	Holes in screen, large debris, damage to housing or weir box	Visual observation	Annually or after a cleanout.	Immediately consult with engineer and manufacturer's representative to develop a course of action, effect repairs prior to the wet season.	None			0				0			0	Hours accounted for during inspections
TOTAL CDS UNITS						72		3141.36				596.25		1800	5537.61	
DRAIN INLET INSERTS – FOSSIL FILTER																

APPENDIX H Estimated O & M Costs for BMP Project

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						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Inspect for debris/trash	Sufficient debris/trash that could interfere with proper functioning of insert	Visual observation	During the wet season:				43.63	0				0			0	
Before and once during each target2 storm (0.25 in) event				Remove and properly dispose of debris/trash. Target completion period while onsite conducting inspection.		18	43.63	785.34				0			785.34	
Oil and grease removal	Absorbent granules dark gray, or darker, or unit clogged with sediment.	Visual observation	At the end of each target2 storm (0.25 in) event	Replace Fossil FilterTM adsorbent within 10 working days. Characterize and properly dispose spent media prior to wet season.		2	43.63	87.26				0			87.26	
Inspection for structural integrity	Broken or otherwise damaged insert	Visual observation	Twice per year in October and May.	Replace insert or immediately consult vendor to develop course of action, effect repairs within 10 working days	None	2	43.63	87.26				0			87.26	
Annual renewal of medium	End of wet season, April 30	None	Annually, in May	Remove, characterize, and properly dispose of media a Replace media before Oct 1	None	2	43.63	87.26	sedan	1	21.28	21.28	new adsorbent and testing & disposal costs	115	223.54	
TOTAL DRAIN INLET INSERTS-FOSSIL FILTERS						24		1047.12				21.28		115	1183.4	
DRAIN INLET INSERTS – STREAM GUARD																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Sediment removal	Sediment more than 6-inches	Visual inspection of sediment collected within insert	During the wet season:	Replace insert. Target completion while onsite conducting inspection.				0				0			0	
Inspect for debris/trash	Sufficient debris/trash that could interfere with proper functioning of insert	Visual observation	During the wet season	Remove and dispose of debris/trash. Target completion period while onsite conducting inspection.				0				0			0	
Oil and grease removal	When oil absorbent polymer becomes saturated with oil	Visual observation (absorbent polymer expansion indicates oil saturation)	Monthly	Within 10 working days, replace oil absorbent polymer		2	43.63	87.26				0			87.26	
Inspection for structural integrity	Signs of rips, gashes, and/or fallen media	Visual observation	Twice per year in October and May.	Replace insert or immediately consult vendor to develop a course of action, effect repairs within 10 working days	None	2	43.63	87.26				0			87.26	

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						Labor			Equipment				Materials		Total	Comments
						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
Annual renewal of medium	End of wet season, April 30	None	Annually, In May	Remove characterize, and properly dispose of media.. Replace media before Oct 1	None	2	43.63	87.26	sedan	1	21.28	21.28	new adsorbent and testing & disposal costs	195	303.54	
TOTAL DRAIN INLET INSERTS-STREAM GUARDS						6		261.78				21.28		195	478.06	
EXTENDED DETENTION BASINS																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Basin side slope planted for erosion protection and planted invert	Average vegetation height greater than 12-inches, emergence of trees or woody vegetation,	Visual observation and random measurements through out the side slope area	Once during wet season, once during dry season.	Cut vegetation to an average height of 6-inches and remove trimmings. Remove any trees, or woody vegetation.		48	43.63	2094.24	one-ton truck	2	26.84	53.68	string trimmer, rake, fork, bags, safety equipment	50	2197.92	
Slope stability	Evidence of erosion	Visual observation	October each year	Reseed/revegetate barren spots prior to wet season.		0	43.63	0	one-ton truck & hydroseeder	0	48.15	0	seed	150	150	
				Contact environmental or landscape architect for appropriate seed mix.												
				Scarify surface if needed.												
				If after two applications (2 seasons) of reseeding/revegetating and growth is unsuccessful both times, an erosion blanket or equivalent protection will be installed over eroding areas. No erosion blanket will be installed in the basin invert.	NOT AN ANNUAL COST	0	43.63	0	one-ton truck	0	26.84	0	blanket	0	0	
Inspect for standing water.	Standing water for more than 72 hours	Visual observation	Annually, 72 hours after a target2 storm (0.75 in) event	Drain facility	None											
				Check and unclog clogged orifice.	Should be Annual Mtce.											
				Notify engineer, if immediate solution is not evident.												
Inspection for trash and debris	Debris/trash present	Visual observation	During routine trashing, per Districts schedule.	Remove and dispose of trash and debris	None											
Inspection for sediment management and characterization of sediment for removal	Sediment depth exceeds marker on staff gage	Measure depth at apparent maximum and minimum accumulation of sediment. Calculate average depth	Annually	Remove and properly dispose of sediment. Regrade if necessary.		16	43.63	698.08	4-yd dump truck, backhoe & traller, one-ton truck & hydroseederse dan	0.4	176.5	70.6	testing and disposal	460	1228.68	once every 5 years

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						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
Inspect for burrows	Burrows, holes, mounds	Visual observation	Annually and after vegetation trimming.	Where burrows cause seepage, erosion and leakage, backfill firmly.												
General Maintenance Inspection	Inlet structures, outlet structures, side slopes or other features damaged, significant erosion, emergence of trees or woody vegetation, graffiti or vandalism, fence damage, etc.	Visual observation	Semi-Annually, late wet season and late dry season Monthly	Corrective action prior to wet season. Consult engineers if immediate solution is not evident.	None	16	43.63	698.08	one-ton truck	2	26.84	53.68			751.76	
TOTAL EXTENDED BASIN						80		3490.4				177.96		660	4328.36	
INFILTRATION BASINS																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Vegetation of basin invert and side slopes	Vegetation height exceeds 12 inches, emergence of trees or woody vegetation,	Visual observation and random measurements through out the side slope and invert area	Once during wet season, once during dry season.	Cut vegetation to an average height of 6-inches. Remove any trees, or woody vegetation.	None	48	43.63	2094.24	two-ton truck	2	50	100	string trimmer, rake, fork, bags, safety equipment	50	2244.24	
Inspect for standing water.	Standing water for more than 72 hours	Visual observation	Annually, 72 hours after a target2 storm (0.75 in) event.	Drain facility, if possible.		16	43.63	698.08	one-ton truck	4	26.84	107.36			805.44	
				Notify engineer to consider:												
				Remove sediment, scarify invert, and regrade if necessary.				0				0			0	covered under sediment removal
				If unable to achieve acceptable infiltration rate or implement alternative solution then move to decommission				0				0			0	
				If standing water can not be removed then notify VCD.	None											
Inspection for trash and debris at inlet structures	Debris/trash present	Visual observation	During routine trashing, per Districts schedule.	Remove and dispose of trash and debris	None											
Inspection for sediment accumulation	Sediment depth exceeds marker on staff gage.	Measure depth at apparent maximum and minimum accumulation of sediment. Calculate average depth	Annually	Remove, characterize and properly dispose of sediment. Regrade and revegetate bare areas.	None	4	43.63	174.52	4-yd dump truck, loader & trailer, grader, sedan, one-ton truck & hydroseeder	0.5	256.94	128.47	seed, testing & disposal	150	452.99	once every 10 years
Slope stability	Evidence of erosion.	Visual observation	October each year.	Reseed/revegetate barren spots by Nov. Scarify surface if needed.		20	43.63	872.6	one-ton truck & hydroseeder	1	48.15	48.15	seed	275	1195.75	

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						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
Inspect for sediment accumulation in sedimentation chamber	Sediment depth exceeds marker on staff gage.	Measure with appropriate device	Measure sediment depth annually.	Remove sediment prior to wet season. Characterize sediment and properly dispose.		8	43.63	349.04	boom truck	0.33	74.94	24.7302	drums, shovel, rake, drum grappler, confined space equipment characterization and disposal	833	1206.77	every 3 years
Inspection for trash / debris	Trash and debris present	Visual observation	During routine trashing, per Districts schedule.	Remove and dispose of trash and debris during routine trashing.	None	24	43.63	1047.12	one-ton truck	2	26.84	53.68	confined space equipment	50	1150.8	
Inspect for burrows	Burrows, holes, mounds.	Visual observation	Annual inspections after vegetation trimming.	□ Where burrows cause seepage, erosion and leakage, backfill firmly.	None			0				0			0	
Inspect for standing water	Water accumulation in any structure or other location within the filter	Standing water in any structure or other location within the filter	Annually, 72 hours after a target2 storm (0.75 in)	□ Gravity drain where possible.		4	43.63	174.52	one-ton truck	1	26.84	26.84			201.36	
				□ Notify engineer, if immediate solution is not evident.		2	43.63	87.26				0			87.26	
				□ If standing water can not be removed or remains through wet season notify VCD.	None	2	43.63	87.26				0			87.26	Does not include Vector Control Agency costs
General Maintenance Inspection	Inlet structures, outlet structures, filter fabric or other features damaged, emergence of vegetation, graffiti or vandalism, fence damage, etc.	Visual observation	Semi-Annually, late wet season and late dry season Monthly	Within 30 working days, take corrective action. Consult engineer if immediate solution is not evident.	None	8	43.63	349.04	one-ton truck	2	26.84	53.68			402.72	
TOTAL MRDIA FILTER-SAND W/O/PUMP						60		2617.8				210.5		1716	4544.3	
MULTI-CHAMBER TREATMENT TRAINS																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											
Maximum filter drain time of 72 hrs for design and smaller storms	Drain time greater than 72 hours or sediment accumulation is greater than 0.1 inch over more than 50 percent of the fabric surface area.	Visual observation	After one target2 storm (0.75 in) event during wet season.	□ Remove and replace filter fabric blanket.		4	43.63	174.52	one-ton truck	1	26.84	26.84			201.36	
				□ If problem persists, consult with engineer, the media may need to be replaced. Complete prior to wet season.	None	2	43.63	87.26		0	0	0		0	87.26	

APPENDIX H Estimated O & M Costs for BMP Project

Estimated vlaues derived from Caltrans Pilot BMP Study. This spreadsheet will change as additional data becomes available.						Labor			Equipment				Materials		Total	Comments
						Per. Hrs	Rate	Cost	Type	Days	rate	Cost	Item	Cost	Cost	
Inspection for trash/ debris at inlet and outlet structures and the MCTT	Trash and debris present	Visual observation	.During routine trashing per District schedule	Remove and dispose of trash and debris During routine trashings.	None	0	43.63	0	one-ton truck	0	26.84	0	confined space equipment	50	50	
Inspection for sediment accumulation	Sediment accumulates 50% of the volume underneath the tube settlers. Maximum of 2-feet grit chamber	Measure with appropriate device	Remove tube settler, measure sediment depth annually	Remove sediment prior to wet season. Characterize sediment and properly dispose.	None	36	43.63	1570.68	one-ton truck	1	26.84	26.84	drums, shovel, rake, drum grappler, confined space equipment, characterization and disposal	600	2197.52	
				□ If standing water can not be removed or remains through the wet season notify VCD.	None	2	43.63	87.26				0			87.26	Does not include Vector Control Agency costs
Replace filter media every 3 years per designer's specification	Operation greater than 3 years	Not applicable	Every 3 years	Remove and replace filter media. Characterize and properly dispose.	None	8	43.63	349.04	vactor and one-ton truck	0.33	198.75	65.5875	confined space equipment, characterization and disposal	1200	1614.628	every three yea
Inspect sorbent pillows in main settling chamber	Darkened by oily material	Visual Observation	Annually, in May.	Annually, renew sorbent pillows, or immediately if pillows are darkened by oily material, characterize and properly dispose.	None	4	43.63	174.52	one-ton truck	1	26.84	26.84	sorbent pillov	100	301.36	
Inspect pumps for proper functioning	Pump does not operate	Energize pump to see if water is discharged	After every storm.	Make assessment to determine if problem is electrical or mechanical. Take appropriate action. Replace pump if needed.	None	0	43.63	0	one-ton truck	0	26.84	0	confined space equipment	0	0	
Inspect pumps for serviceability and periodic maintenance	Per manufacture's guidelines	Per manufacture's guidelines	Per manufacture's guidelines	Per manufacture's guidelines	None	0	55.7	0	one-ton truck	0	26.84	0	confined space equipment, pump or parts	0	0	
General Maintenance Inspection	Inlet structures, outlet structures, filter fabric, settling tubes or other features damaged, emergence of vegetation, graffiti or vandalism, fence damage, etc.	Visual observation	Semi-Annually, late wet season and late dry season	Within 30 working days, take corrective action. Consult engineer if immediate solution is not evident.	None	8	43.63	349.04	one-ton truck	2	26.84	53.68			402.72	
TOTAL MULTI-CHAMBER TREATMENT TRAINS						64		2792.32				199.788		1950	4942.108	
OIL-WATER SEPARATOR																
Preventive Maintenance and Routine Inspections																
DESIGN CRITERIA,																
ROUTINE ACTIONS	MAINTENANCE INDICATOR	FIELD MEASUREMENT	MEASUREMENT FREQUENCY	MAINTENANCE ACTIVITY	SITE-SPECIFIC REQUIREMENTS											

The table below provides the anticipated capital and annual maintenance costs for the selected BMPs.

BMP Option	Estimated Capital Cost [1]	Approximate Annual Maintenance Cost
Grass swales	$0.75 per square foot	$350 per acre of grass swale [2]
(1) ClearStream Water Quality Vault Model 2056	$35,500.00 + installation	$1500
ClearWater Curb Inlet Filters	$3695 per inlet [3]	$335 per unit [4]
10,584 ft^3 Contech Con/Span Vault (underground detention)	$85,200	$300 [5]

(1) A proprietary BMP may vary in cost at the manufacturer's discretion.
(2) Annual maintenance costs are incorporated into the annual landscaping maintenance costs.
(3) Installation included.
(4) Cost covers one inspection/maintenance visit on one unit. Maintenance required after 6" to 8" of rain; annual monitoring available for an additional $300 per unit.
(5) Annual inspections, until vault requires sediment removal (min of once every 10 years).

The Developer will incur the capital cost for the BMP installation. The responsible party for long-term maintenance and funding is the Business Owners Association (BOA) for California Crossing.

ATTACHMENT G

Tracking Report